ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

JANUARY 14, 1950 • OUR 74th YEAR

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•

Electric Space Heating In Northern Climes

•

Efficient Mechanical Rectifier

3-Kv Line Built at Record Speed

Year After Year

You Can Count On

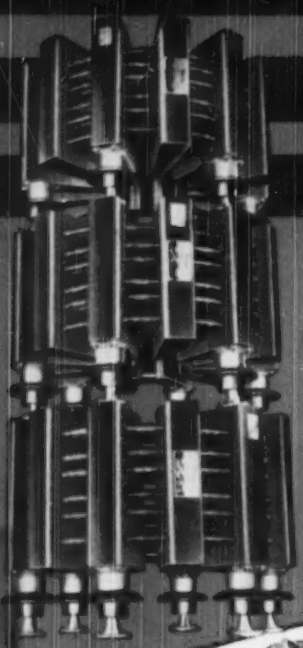
Dependable Circuit Protection

WITH

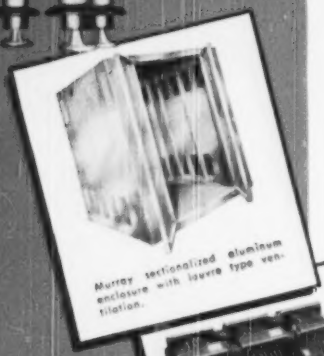
Murray

CAST-IN-CONCRETE
Current-Limiting Reactors

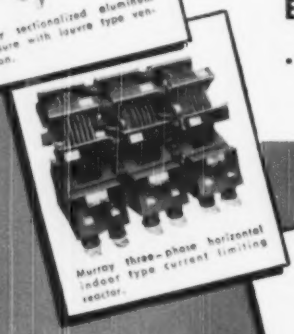
Engineered to your specifications...
...for indoor or outdoor service.



Typical Murray three-phase vertical outdoor type cast-in-concrete current limiting reactor.

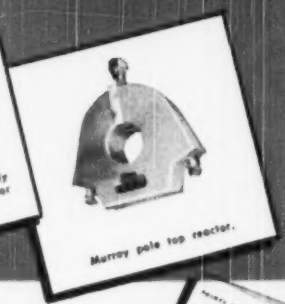


Murray sectionalized aluminum enclosure with louvre type ventilation.



Murray three-phase horizontal indoor type current limiting reactor.

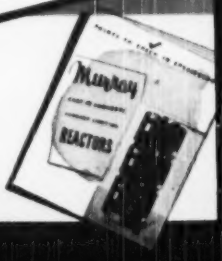
Murray single-phase completely cast-in-concrete vertical outdoor type reactor.



Murray pole top reactor.

Feeder
Generator
Motor Starting
Neutral Grounding
Transformer Equalizing
Special Purpose
Station Tie
Bus Tie
Shunt
} Reactors

To help you give detailed information on reactors for your individual application, this comprehensive folder has been especially prepared. It provides a reliable guide to points to check in specifying all types of cast-in-concrete current limiting reactors. Write Murray for your copy today.



Murray

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50 Years of Service to the Electrical Industry

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SERVICE ENTRANCE & METER EQUIPMENT • MAGNETIC CIRCUIT BREAKERS
SWITCHES • CURRENT LIMITING REACTORS • CROWS NEST AERIAL LADDERS

ELECTRICAL WORLD

Published for 76 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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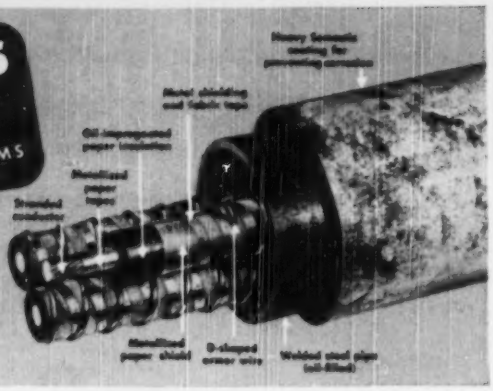
ANY WAY YOU FIGURE IT . . .

FIRST CHOICE IS OILSTATIC

HIGH-PRESSURE PIPE-TYPE CABLE SYSTEMS



FIGURED BY CIRCUITS . . . It's 4 to 1 (for generator leads — 100%)

Here are the figures by circuits installed or under contract as of September 1, 1949:

Pipe-Type System	Transmission Circuits	Generator Lead Circuits
High-Pressure Oil (Oilostatic Type)	44	25
Compression Oil	5	—
High-Pressure Gas	11	—
Compression Gas	2	—
Total	62	25

A total of 87 circuits of all types have been purchased and, of these, 80% (69 circuits), are of the Oilostatic type. For generator lead circuits alone, 100% are of the Oilostatic type. Okonite-Callender has supplied 56 of the 69 Oilostatic type circuits.

FIGURED BY UTILITIES . . . It's 3 to 1

Here are the figures by number of utilities purchasing these systems:

Pipe-Type System	No. of Utilities
High-Pressure Oil (Oilostatic Type)	21
Compression Oil	3
High-Pressure Gas	4
Compression Gas	2
Total	30

A total of 27 separate power and light companies have purchased high-pressure pipe-type systems, one having as many as 12 separate circuits in operation. Only three utilities have installed 2 types of cable systems. Oilostatic-type systems, however, have been purchased by 21 or 3 out of 4 of these 27 utilities.

OTHER OILOSTATIC FIRSTS In High-Pressure Pipe-Type Cables

- 1st transmission system, 1935
- 1st application of high-pressure 161-kv potheads, 1935
- 1st generator lead installation, 1941
- 1st cabinet-type packaged pumping unit, 1946
- 1st submarine crossing, 1947
- 1st termination directly into transformer, 1949

There are good reasons why Oilostatic* high oil-pressure pipe-type cable systems have become the predominant choice of power and light companies within so few years. Oilostatic type systems offer a combination of advantages that increase circuit reliability, save money and labor.

Higher Dielectric Strength — entirely immersed in oil under 200 lbs. pressure to insure its high dielectric characteristics; no voids in the insulation, therefore no ionization.

Greater Simplicity — space saving: no ducts, no lead sheath; no riser cable problems; relieves congestion at points where overhead lines are impractical; also saves space in generator stations.

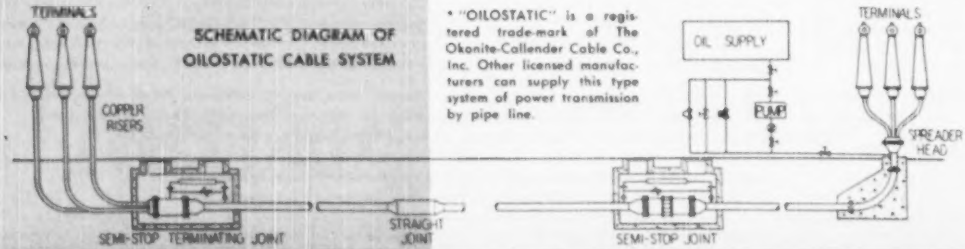
Easy Installation — all phases installed simultaneously in pulls up to 3600 ft.; simple joints and terminals.

Broad Transmission Applications — highest current carrying capacity under emergency overload; no practical voltage limit; cables can be furnished for any present-day operating voltages.

Substantial Savings — when used in preference to a duct system, savings from 15 to 30% are obtained in city street installations; in open country 25 to 40% may be effected.

Same installation for land or submarine projects — unaffected by elevation, contour or nature of terrain.

Quick and easy to install, of rugged construction and requiring very little maintenance, dependable Oilostatic may be the answer to your problem when handling bulk power. For complete installation and operating details, let an Okonite engineer consult with you. Also, for your information and help is Okonite's 16 mm. colored, "Oilostatic" film, supplemented by Oilostatic File Folder EW 75. Both are available upon request. Call or write to The Okonite Company, Passaic, New Jersey.



* "OILOSTATIC" is a registered trade-mark of The Okonite-Callender Cable Co., Inc. Other licensed manufacturers can supply this type system of power transmission by pipe line.

OKONITE-CALLENDER paper insulated power cables

9141

TOP LINES
for all lines

. . . are available from Graybar

For distribution or transmission lines — construction or maintenance — Graybar has all the *supply* lines you need. You can count on every item, because Graybar's standards of selection are tough! Everything Graybar distributes is a product of a leading manufacturer. Its efficiency and reliability have been tested, proved, and improved through years of research and field service.

POLES AND CROSSARMS

Graybar-selected poles — full-length pressure-treated pine and fir; and full-length pressure-treated, butt-incised cedar. Rainier fir crossarms that have the proven strength and durability to resist taxing combinations of heavy conductor load and shock from snow, ice, and wind.

Wire, strand, hardware

Crapo strand and high-strength static wire to fit your specifications . . . Hubbard braces, brackets, and racks for long-lasting pole structures . . . Chance pole anchors for guying of all types . . . Reliable connectors for quick, secure tap-offs . . . rugged O-B insulators . . . and everything else the project requires!

ALL THE TOOLS, TOO!

Help your linemen do each job quickly, efficiently, and safely — supply them with all the proper tools. Graybar has everything from pliers and rubber gloves to FWD line trucks. To round out our complete service, there is a Graybar Outside Construction Specialist to consult with you on any special problem "from the bottom of the hole to the top of the pole." *Graybar Electric Company, Inc. Executive Offices: Graybar Building, New York 17, New York.* 4955

You get the best of everything electrical
Via GraybaR

IN OVER 100 PRINCIPAL CITIES

PROOF - *not Guesswork*

Makes FWD America's Foremost Heavy-Duty Truck

Here's actual operating proof by one of the nation's leading utilities. This FWD line construction unit is lifting itself up and over obstacles to get to location. Rough going such as this demands climbing ability only four driving wheels provide. What's more, with FWD, you can be sure of this even before you buy.

And here's why. FWD Built-to-Code Units are scientifically tested on FWD's proving ground to climb up and over an 8-inch beam from a standstill. *No wonder over 200 of the nation's top utilities use FWDs for line construction and maintenance work — with individual fleets up to 192 units!*

WHAT FWDs DO ON THE PROVING GROUND
1 Highball over hilly curved roads!
2 Slog thru mud — up to the bumper!
3 Speed over 100 ft. unbanked circle!
4 Twist over ditches — 18 inches deep!
5 Drive up 6% grade thru 3 ft. of sand!
6 Climb 70% grade from dead stop!
7 Climb 8-in. beam from standstill!
8 Drill pole holes to prove equipment!
9 Speed safely over level highways!
1
2
3
5
6
7
8
9

This is FWD's proving ground. This is your assurance that the FWD you select has the stamina to insure long life without expensive mechanical breakdowns.

An FWD pulls itself over an 8-inch beam at the proving ground. For all the facts about FWD Built-to-Code Units, see your Graybar distributor — or write FWD.

An Invitation To Fire Engine Buyers

We invite you to watch FWDs pass a series of the most rigid performance tests. Ask your FWD distributor to arrange your visit to our plant. Or—if you can't get away, ask him to show you the movie, *The FWD Story*. In either case, you will see for yourself how FWDs can help solve your fire fighting problems.

President
The Four Wheel Drive Auto Company

V-4

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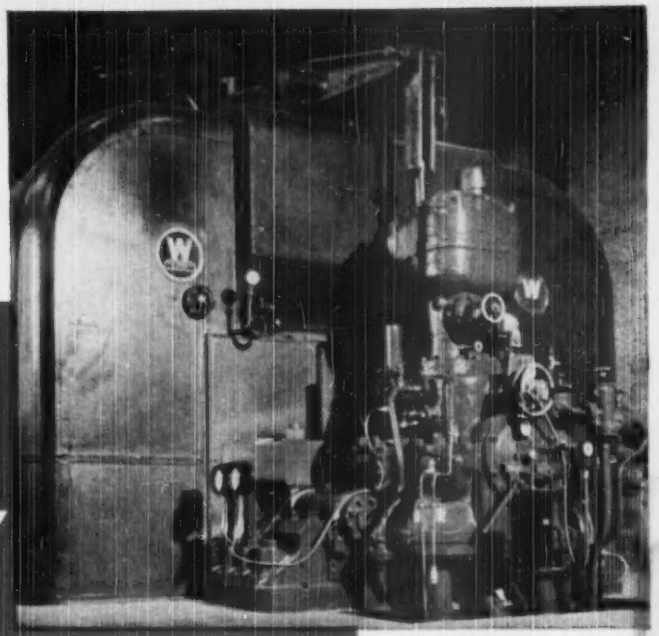
Clintonville, Wis. • *Canadian Factory:* Kitchener, Ontario
FOUR AND SIX WHEEL DRIVE TRUCKS

America's Foremost Heavy-Duty Truck



GET 3-WAY PROTECTION

Lubricate with TEXACO REGAL OILS (R&O)

Your turbines get full protection against the dangers of (1) rust, (2) sludge, and (3) foam, when you use *Texaco Regal Oils (R & O)*. Only the choicest base stocks are used in making these world-famous oils. They are specially refined, fortified with rust and oxidation inhibitors, and processed to prevent foaming.

Texaco Regal Oils (R & O) thus keep turbine lubricating systems clean through extra years of service life. This means bearings are kept smooth and safe in a constant flow of cool, clean oil . . . governor response is always sensitive and swift.

Texaco Regal Oils (R & O) meet the exacting requirements of all leading turbine builders, and the turbine oil specifications of the United States Navy.

Get an extra margin of safety by using *Texaco Regal Oils (R & O)*. A Texaco Lubricating Engineer will gladly explain to you in detail. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

TEXACO

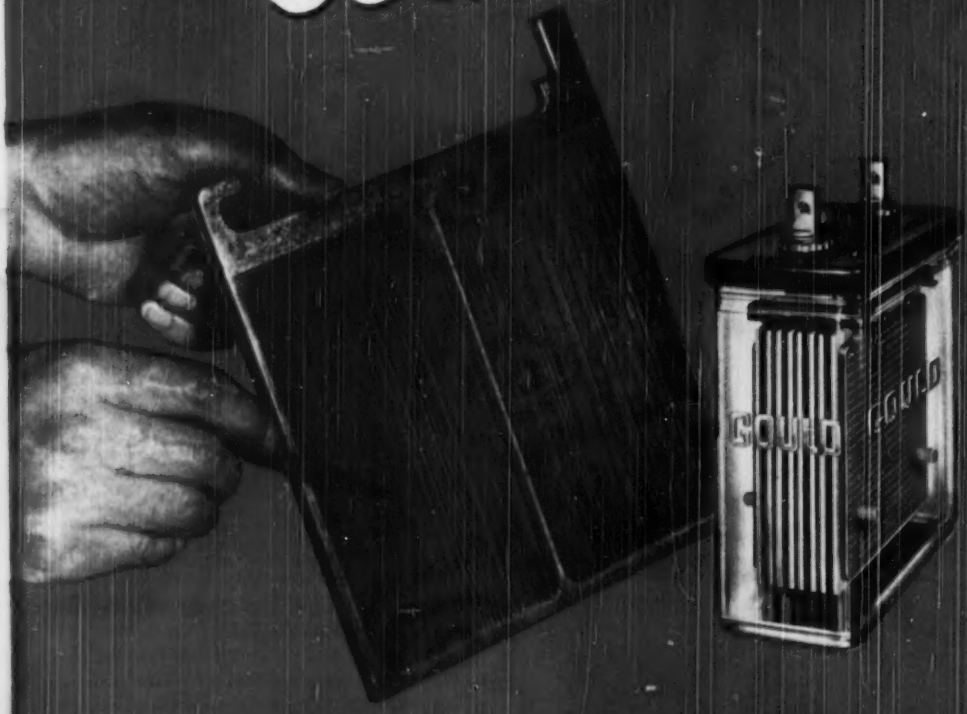
TEXACO Regal Oils (R&O)

FOR ALL TURBINES

TEXACO presents MILTON BERLE on television every Tuesday night. METROPOLITAN OPERA radio broadcasts every Saturday afternoon.

YOU GET UNEQUALLED SERVICE

WITH GOULD PLANTE



See that Planté plate? It's the only pure lead positive plate in any battery . . . and is the reason why Gould Planté delivers unfailing power for more years, at lowest cost, than any other battery.

Only Planté pure lead positives contain no antimonial impurity to contaminate negative plates. Such contamination cuts battery capacity, builds up required float voltage, and shortens battery life.

That's why Gould Planté batteries consistently roll up amazing service records wherever they are used. That's why Planté batteries are the Aristocrats of Stationary Batteries.

OTHER GOULD TYPES—Planté, Kathanode and Dreadnought—offer a complete line to cover all capital expenditure, service, capacity and cost requirements. Our "Battery Selector," GB-852, gives full information. Write for your copy today.

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TRENTON 7, NEW JERSEY

Always Use Gould Autocrabbie and Truck Batteries

STANDARDIZED to Save You Time, Money!

ALLIS-CHALMERS
Standard Type "O" Oil Circuit Breaker
FOR SYSTEMS UP TO 23 KV, UP TO 250,000 KVA INTERRUPTING CAPACITY

- Complete Automatic Reclosing
- Factory Assembled and Wired
- Standard Protective Relay Equipment
- Ready to Install and Operate

YOU'LL SAVE TIME AND MONEY with standardized, completely packaged Type "O" protection. Standardization is your assurance of proved design . . . saves you time in ordering . . . shortens delivery . . . reduces installation time . . . means greater economy passed along to you in dollar savings!

Type "O" outdoor oil circuit breakers clear faults fast. When breaker is tripped, full mechanically and electrically trip-free operating mechanisms release contacts *immediately* under all conditions. Fault or overload currents are cleared within 8 cycles . . . breaker opens and recloses within 30 cycles when connected for automatic reclosing. ASA standard ratings in 7.2, 14.4 and 23 kv sizes.

Get more facts about Type "O" or other breakers from your nearby A-C sales office. Or write for bulletins.

Type OZ-210, 3 pole, 15 kv, 600 amp Outdoor Oil Circuit Breakers installed in Middle-West.

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

Building Fine Power Circuit Breakers Since 1899

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FOR EXPANDING CONTROL SYSTEMS...

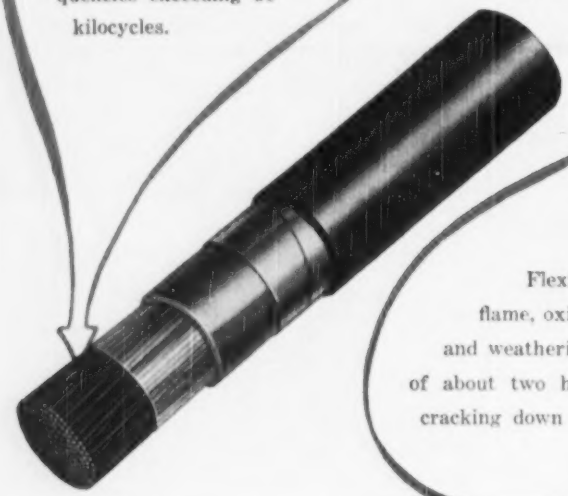
A 1-2 PUNCH THAT K.O.'s HIGH COST

Polyethylene insulation! PLASTEX jacket! In Simplex Polyethylene Control Cables this hard-hitting combination provides utilities with a sure-fire means of keeping down the cost while boosting the performance of those steadily-expanding control systems. . . . It results in a cable of unusually small diameter and light weight, allowing more conductors per cable for a given diameter and more circuits per conduit, keeping purchase cost low, and eliminating much of the time and labor needed for installation. . . . It assures low maintenance costs for it provides the electrical and mechanical stability that means long, trouble-free service under all operating conditions. Yes, when you're drawing up plans for new control circuits you can look to this team as a sure bet to knock down costs and keep them down. Why not get complete information now? Simply fill in and mail the coupon below.

1

POLYETHYLENE INSULATION

Thin-wall; small in diameter. Features high dielectric strength, high insulation resistance, low water absorption and good electrical stability. Its low power factor and dielectric constant assure low attenuation, low capacitance, and maximum transmission distance. Especially suitable for circuits operating at carrier frequencies exceeding 50 kilocycles.



2

PLASTEX JACKET

Flexible. Tough. Protects cable against flame, oxidation, water, oil, chemicals, sunlight and weathering. Stable over a temperature range of about two hundred degrees Fahrenheit. Resists cracking down to —58 F.

SIMPLEX WIRE & CABLE CO.
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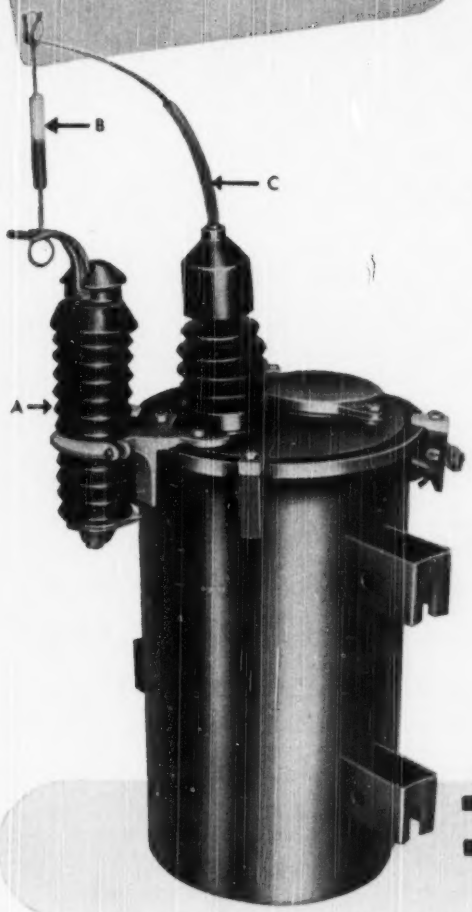
SIMPLEX WIRES & CABLES

SIMPLEX WIRE & CABLE CO.
79 Sidney Street
CAMBRIDGE 39, MASS.

Wagner Rural-Line Transformers . . .

. . . Service Proved FOR MINIMUM MAINTENANCE!

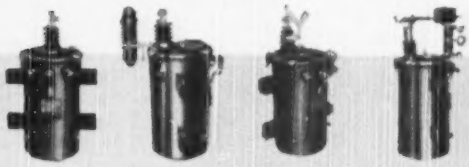


Maintenance costs money—lots of money. Cost analyses show that continued operation is a major factor to consider when buying transformers. It *pays* to choose transformers that are service proved . . . for long life . . . for dependable performance . . . for minimum maintenance.

Service records from the field prove that Wagner Rural-Line Transformers require a minimum of attention and give unusually long, efficient service.

PERFORMANCE *Plus* PROTECTION

Wagner makes a complete line of rural transformers and offers a selection of types with protective features to meet your specific needs. Type HEF-7Z, illustrated at left, provides a wide margin of safety under all surge conditions with an expulsion-type lightning arrester (A) which is grounded through the transformer tank; and provides overload protection by a primary load limiter fuse (B) mounted on a spring arm assembly (C). Other protected types and a conventional type are shown below. Bulletin TU-1C gives complete details, write for your copy.



Wagner's nationwide organization provides fast, convenient service, with 29 branches ready to help you with your transformer problems.

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

Wagner Electric Corporation EST. 1891

ELECTRIC MOTORS - TRANSFORMERS - INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS - AIR AND HYDRAULIC

BRANCHES IN 29 PRINCIPAL CITIES

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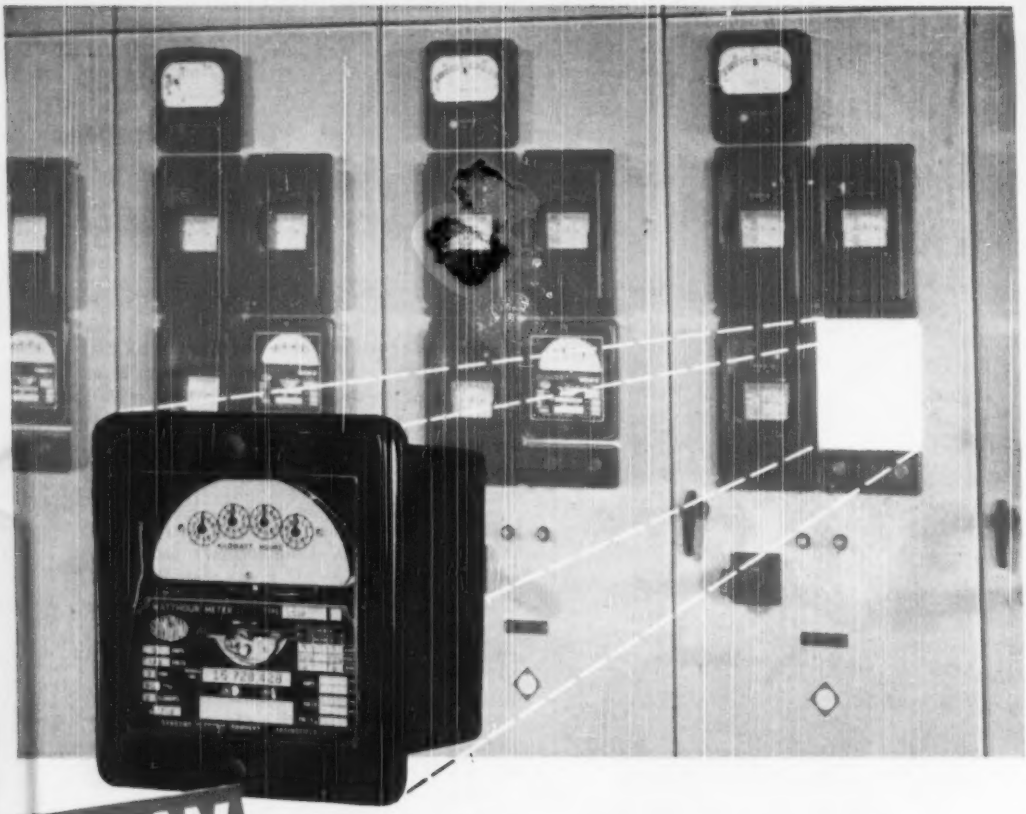


NOW...**all types of Sangamo Watthour Meters available for convenient *SEMI-FLUSH* mounting on modern switchboards!**

The complete, service-proved line of Sangamo Watthour Meters is now available for semi-flush mounting on modern switchboards.

Type LCF meters, for polyphase circuits, and Type JF meters, for single-phase circuits, are built in all current and voltage ratings for which standard service type watthour meters are made—all require the same minimum switchboard area. These meters are offered with either kilowatthour registers or with registers measuring both kilowatthours and kilowatt demand. Type D5F, two-wire, direct current meters are also furnished in the new design.

Sangamo Meters for semi-flush mounting fit a $6\frac{1}{8}$" x $6\frac{5}{8}$" opening in the panel and mount with two screws. The cover can be easily removed to permit ready access to the various adjustments for full load, light load, power factor and element balance without removing the meter from the panel. All adjustments can be made from the front with a screwdriver. A micrometer slide-wire device is provided for making accurate power factor adjustments.

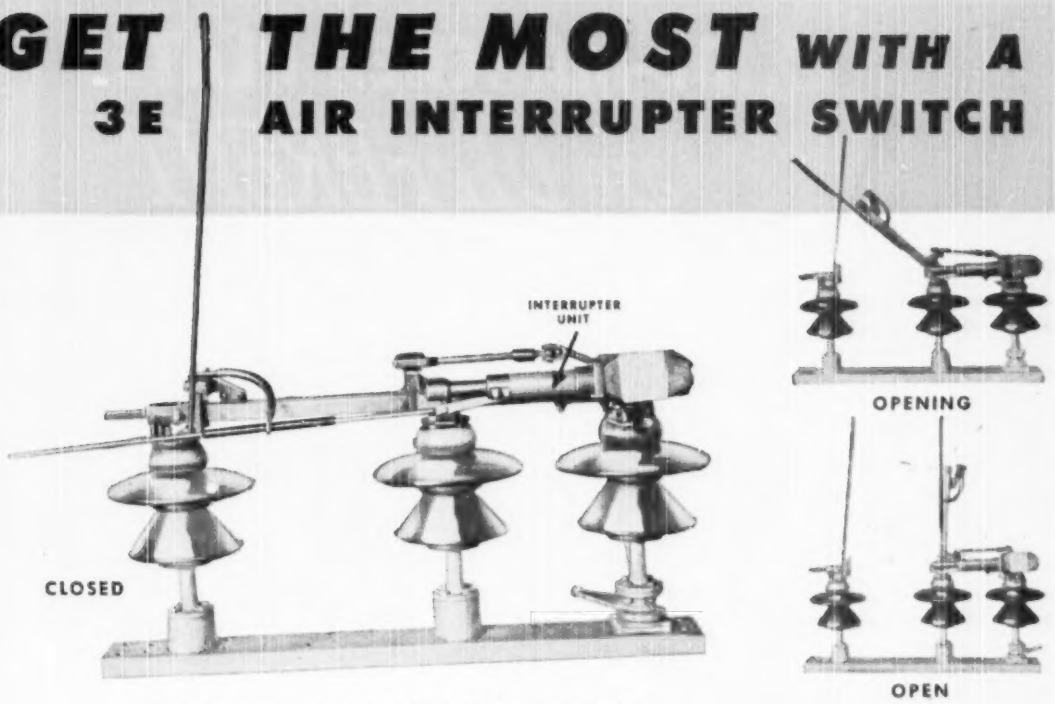
Bulletin No. 270 gives complete information. Write for your copy.

SANGAMO

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

GET THE MOST WITH A 3E AIR INTERRUPTER SWITCH



The Opening Cycle of the 8400-I Air Interrupter Switch

Three E Air Interrupter switches can successfully perform many high voltage switching operations not possible with disconnects or horn gap switches. Furthermore many operations for which expensive oil circuit breakers are being used can be entrusted to these new types.

Load, charging, and magnetizing currents can be interrupted at varying capacities up to 69,000 volts.

A unique high speed interrupter unit, illustrated above, is added to our standard air break switches making these operations possible.

Arc created by the interruption is confined and extinguished inside the arcing chamber of the interrupter unit. There is no burning or pitting of contacts.

INTERRUPTER UNIT

When you specify high voltage switches, why not specify Three E Air Interrupter Switches and get all these extras?

Write for our new Bulletin 331 and get the complete story on these highly efficient switches.

Air Interrupter Switches are also built as the 8900-IU type in the tilting insulator design with three insulator stacks per pole.

There are thirty-five Three E selling representatives located throughout the larger cities of the United States. Call the one nearest you.

IN CANADA
Northern Electric
COMPANY LIMITED
In all the Dominion's larger cities

IN MEXICO
Sociedad Electro-Mecanica
Serapio Rendon No. 84
Mexico, D. F.

THREE E
ELECTRICAL ENGINEERS EQUIPMENT CO.
MELROSE PARK, ILLINOIS

EXIDE-MANCHEX PLATES *are* DIFFERENT

The famous and exclusive positive plate is the result of 62 years of battery-building experience. During that time we have learned much about the design and construction of every type of battery for every application. Development work never ceases in improving the performance of Exide Batteries. Our research staff is the largest in the industry. Engineers, chemists, metallurgists, physicists, technicians and their aides, equipped with all the necessary tools and devices, are constantly building and testing various types and kinds of plates and assemblies.

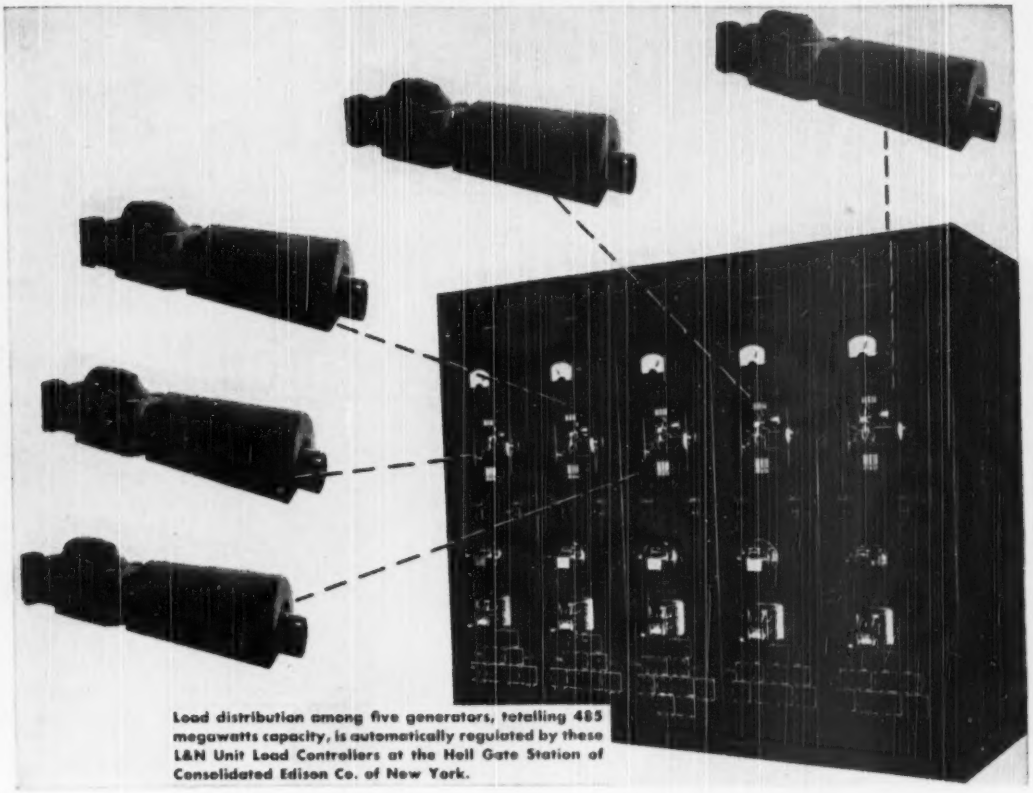
We have yet to find a positive plate with all the desirable characteristics of the Exide-Manchex for use in switchgear and other central and sub-station services. Further proof of its superiority is supplied by long service records in thousands of installations.

For maximum dependability, long life and low cost maintenance, use Exide-Manchex Batteries for all stationary applications. They provide up to 100% more capacity in the same given space.

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

1888—DEPENDABLE BATTERIES FOR 62 YEARS—1950

"Exide-Manchex" *Reg. Trade-mark U. S. Pat. Off.*



Load distribution among five generators, totalling 485 megawatts capacity, is automatically regulated by these L&N Unit Load Controllers at the Hell Gate Station of Consolidated Edison Co. of New York.

"Load Dispatcher" for each unit cuts generation costs

Changes in power demand necessarily mean changes or swings in the amount of power generated—and often affect the cost of producing power. One of the best ways to cut these costs is to spread the load swings among as many generators as possible. Then when load varies, each generator contributes only a relatively small share of the change, and thus can stay at steadier output, close to its own range of best efficiency. In other words, planned distribution reaches a firmer basis all the way down to the individual generators.

The complexity and tediousness of manual load distribution are eliminated in many plants by having this work done automatically through L&N Unit Load Control. Each L&N Controller acts, in effect, as a "load dispatcher" for its own generator. It watches the total load on the station, and when a change comes along, it tells its generator how much of the change to take. The percent of total load assigned to each generator can be varied readily at the operator's discretion, by means of suitable dials. Quickly and efficiently, he can adjust the whole station's generating picture to handle economically any load situation which may arise.

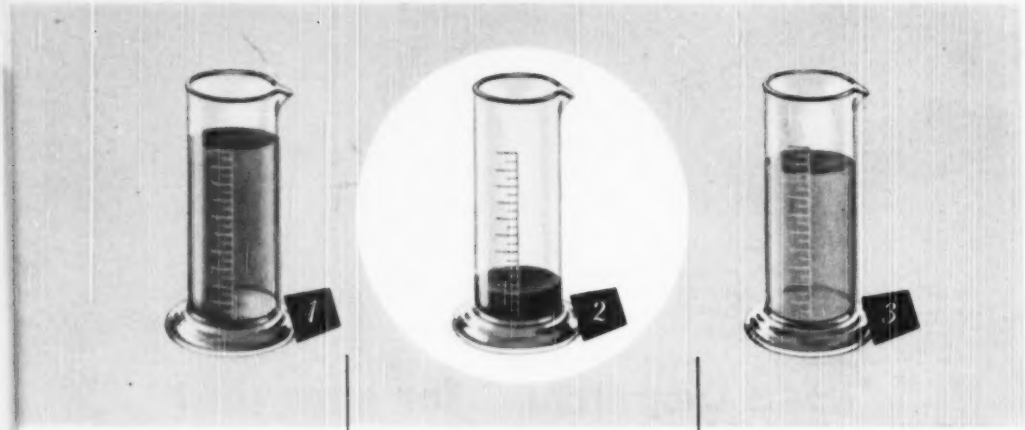
L&N Unit Load Control works with your existing load-frequency control equipment, and can be applied to practically any generating unit. For details, write to Leeds & Northrup Company, 4938 Stenton Avenue, Philadelphia 44, Pennsylvania.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl Ad ND44-56-461(2)

How Alchlor Process "Remove-ability"* gives Gulfcrest Oil its greater stability



In Cylinder 1 you see the oil that will become Gulfcrest. It has gone through the usual steps used in refining most other turbine oils—but has not yet been Alchlor-processed — an extra refining step that makes it extra pure and extra efficient.

*In Cylinder 2 you see the part—as much as 15%—which is discarded by the Alchlor Process. This is the part that, in ordinary turbine oils, is most likely to oxidize, increase neutralization number, and form sludge, emulsifiers, and acids.

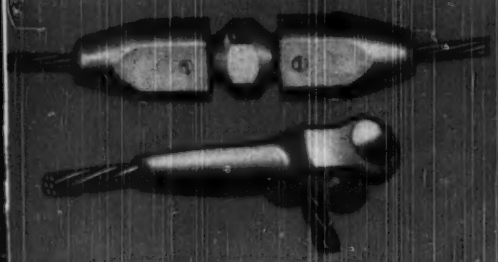
In Cylinder 3 you see the finished Gulfcrest—the incomparably pure lubricating oil that gives outstanding performance and helps you keep steam turbine systems clean indefinitely. To make it even finer, special inhibitors are added to it.

Call in a Gulf Lubrication Engineer today and ask him to recommend the proper grade of Gulfcrest Oil to meet the specific requirements of your turbines. Write, wire, or phone your nearest Gulf office.

Gulf Oil Corporation · Gulf Refining Company

Offices in Principal Cities in 30 States

GULF INDUSTRIAL LUBRICATION



L-M FARGO MESSENGER SPLICES AND DEAD ENDS

Both splice and dead end are available in choice of nut type, like the splice shown, for tightening on the ground, or in fully automatic, shown by the dead end, in which a slight cable tension sets the cones automatically. High strength bronze shell, cones, and lock screws. For Copperweld to ⅝".

OTHER L-M HARDWARE FOR AERIAL CABLE

L-M provides many useful items, such as the double upset extension bolt, which holds messenger clamps with adequate pole clearance; and the double suspension hanger, which supports messenger during stringing, and grips it permanently after bolts are tightened. Steel, with all parts hot dip galvanized.

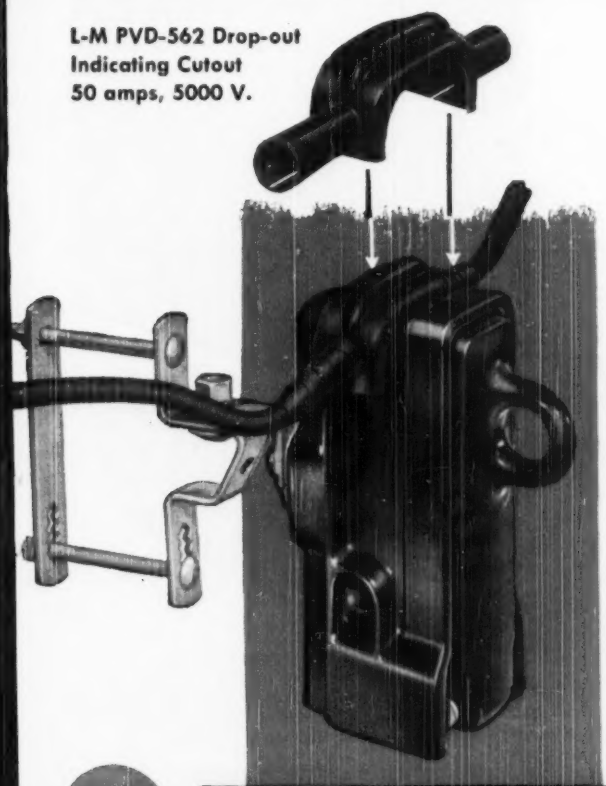
Free!

THIS HANDY GUIDE

Illustrates and describes types of cable, stringing methods, materials, typical installations; 32 pp, indexed. Ask the L-M Field Engineer or write Aerial Cable Materials Division, Line Material Co., Milwaukee 1, Wisconsin.

aerial cable... easy to use with L-M aerial cable materials

L-M PVD-562 Drop-out Indicating Cutout 50 amps, 5000 V.



No "Johnny-come-lately" is L-M in this aerial cable materials business. For years L-M men have worked right alongside of designers, erectors, and users, to test and develop materials that would help simplify the stringing of self-supporting aerial cable, and would help the user enjoy the maximum in service and long life.

In L-M's hardware department, the extensive line of aerial cable materials rates a special division. A few items are shown on this page; many more are described in the bulletin mentioned above. And of course many of L-M's regular hardware and specialty items find application in aerial cable installations.

Discuss your aerial cable problem with the L-M Field Engineer who may give you valuable suggestions; or write Aerial Cable Materials Division, Line Material Company, Milwaukee 1, Wisconsin.

New! L-M aerial cable fuse cutout

The first drop-out cutout designed specially for aerial cable. Same indicating and operating features as the famous L-M PVD-56. But here the conductor runs right through a slot in the top.

You don't cut the cable. Just skin it and drop it into the slot. A copper-jawed clamp grips it firmly without deforming the conductor. The flexible synthetic hood waterproofs the top of the box and protects cut ends of the insulation. Ears of the hood are wrapped around the cable and taped. Makes a neat, fast installation.

LINE MATERIAL... Pole Line Hardware

Complete Coordinated Equipment for All Distribution Requirements 7125

ELEMEX
Capacitors

in stainless steel tanks...

do a good job...good enough to do it!

ELEMEX capacitors produce more pay load on a distribution system by supplying kilovars economically at or near the load. They cut copper losses, raise voltage, and increase carrying capacity of feeders and other equipment.

ELEMEX capacitors do this job well . . . they are good enough to do it for a long time. Highest quality, low-density paper used in each pack . . . humidity-controlled rooms . . . individual control of evacuation and capillary impregnation with ELEMEX liquid . . . step-by-step testing of each individual unit throughout production. Those are some reasons for their outstanding 5-year service record.

Many Desirable Features

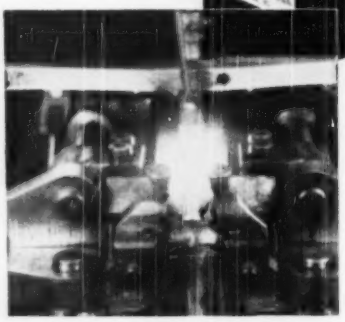
Stainless steel tanks . . . uniform terminal elevation above hangers for both 15 and 25 kvar sizes in each voltage class . . . L-M "Paragroove" connectors . . . L-M "Lifetime" solder-sealed bushings . . . sturdy, wood-reinforced shipping cartons.

Ask the L-M Field Engineer for the whole story; or write Capacitor Division, Line Material Company, Milwaukee 1, Wisconsin.

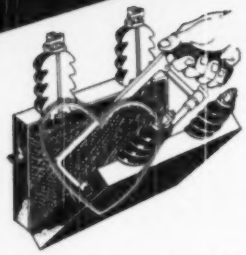
Corrosion-free Welding of Stainless Steel Tanks

ELEMEX capacitors come to you in stainless steel tanks, which never need painting. They save installation time because the lineman doesn't have to repair scratches or gouges caused by handling . . . doesn't have to scrape paint to get a good ground. And they *do* cut maintenance costs!

Tanks and covers are fabricated by the well-known Heliarc welding process. This method applied to stainless steel of very low carbon content assures a finished tank that is free of corrosion—*even at the welds.*



"Heliarc" welding of stainless steel tanks. Arc travels up one side, across, and down the other, I utt-welding the seam visible in the slot in the jig.



Low Unit Stress Assures Long Life

Conservative design, with lowest stress on packs and insulation. Heavy laminated major insulation, folded at the corners without slitting, assures uniformly high impulse strength.

7130

LINE MATERIAL . . . Capacitors

Complete Coordinated Equipment for All Distribution Requirements

Have you seen L-M's latest street lighting development?

the revolutionary new

AUTOLATCH

...the first truly automatic pressure latch!

No gaskets! yet it's bug-proof and water-tight

Service from the ground! any standard hook stick will work

Trouble-free maintenance! Autolatch cuts your lamp maintenance time and costs

Now on the L-M Spherolite . . . soon on Spherolite Jr.

At no increase in price!

L-M's revolutionary new Autolatch provides a minimum of 40 pounds pressure to hold glassware tightly to the reflector. Spring pressure on both latch and hinge sides. Uniformly smooth-surfaced glassware edge fits tightly against machined reflector edge. Bugs, dust, and water stay out. Yet the latch is easy to open. To close, you just swing the glassware back up, and the Autolatch snaps shut—tight.

The Autolatch is just another advantage of L-M's highly efficient Spherolite Luminaire. For complete details of Spherolite, its adaptability to either incandescent or mercury vapor, and the Autolatch, ask the L-M Field Engineer or write Street Lighting Division, Line Material Co., Milwaukee 1, Wisconsin.

2

3

4

5

1. Front view of the revolutionary new Autolatch. Works easily, permits service from the ground, cuts maintenance, no gaskets are necessary—and there's no increase in price!

2. U-shaped metal end fits right under the Autolatch. Tilting the stick outward slightly releases the latch, and the glassware swings down (**3**). (The U-shaped attachment fits the reverse end of your regular lamp stick).

4. Glassware is easily unhooked and replaced. Precisely engineered parts fit smoothly. No gaskets. No screws! It's a 3-second job with the Autolatch—and (**5**) swinging up the glass snaps the Autolatch shut.

LINE MATERIAL Street Lighting

Complete Coordinated Equipment for All Distribution Requirements

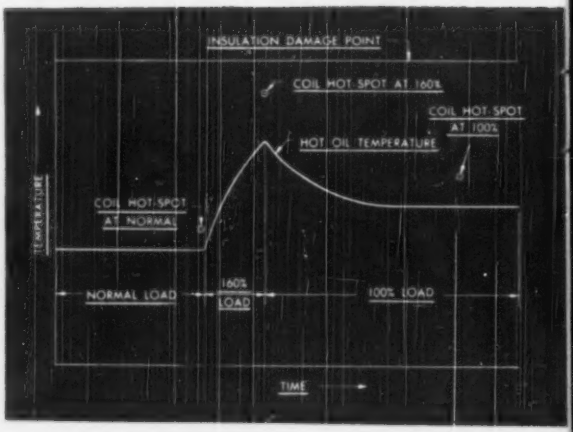
7381

high short time overload capacity because L-M "ROUND-WOUNDS" *have built-in cooling*

Obviously no transformer that develops hot spots because of insufficient coil ventilation will take much of an overload, even for a comparatively short time.

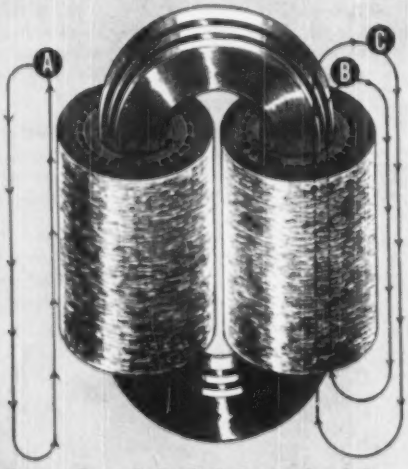
So, to assure real short-time overload capacity, L-M engineers designed a core which has inherently good coil ventilation characteristics. That's what we mean by a cooling system.

No—we aren't recommending Round-Wound 5 kva's for a 10 kva job! But we *do* say that you can expect long life, with an extra margin of short time overload capacity, because of the superior coil cooling of the Round-Wound design.



Typical time-temperature curve for Round-Wound transformers. ▶

The arrows in the illustration below show the flow of cooling oil



Arrows show oil circulation around and through the long round coils, and between core and coils. Exceptional cooling characteristics inherent in the L-M Round-Wound design assure you of unexcelled short-time overload capacity.

As the illustration shows, L-M Round-Wound design provides long round coils which expose more surface (A) to the oil than do shell type transformers. What's more, the Round-Wound design provides oil ducts between the cruciform core and the coils (B) to cool the inner windings. And in the larger sizes we build oil ducts right into the coil windings (C) for still more oil circulation.

How are you going to develop critical hot spots with that kind of cooling? Temperature gradient between windings and top oil remains low, and insulation is protected against damage under severe loading conditions.

Exceptional coil cooling results in high short time overload capacity—one of the several fundamental "Balanced Performance" characteristics found in all L-M Round-Wound transformers. Want more details? Ask the L-M Field Engineer or write Line Material Company, Transformer Division, Zanesville, Ohio.

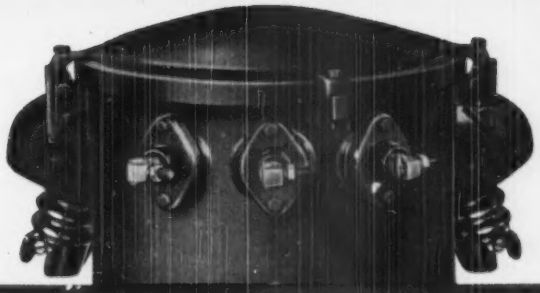
ROUND COILS WOUND COILS

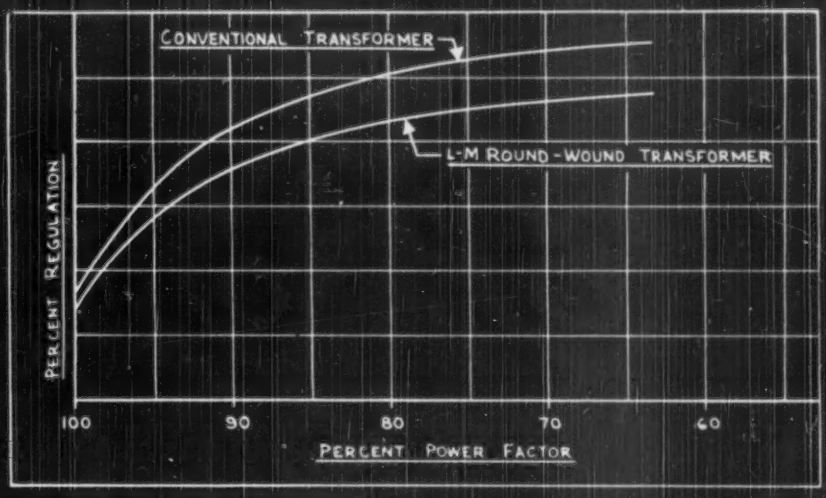
LM

LINE MATERIAL Transformers

Complete Coordinated Equipment for All Distribution Requirements

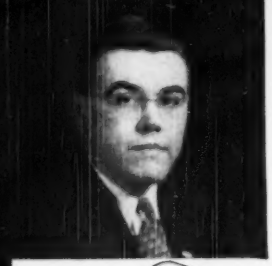
"Better regulation at all power factors..."



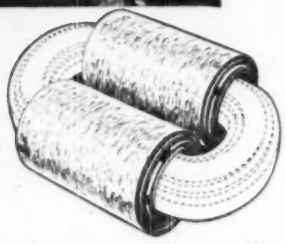


ROUND WOUND

Robert P. Thompson,
Transformer Design Engineer,
Line Material Company,
Zanesville, Ohio



a major advantage of L-M ROUND-WOUND transformers," says ENGINEER THOMPSON



Continuous wound core, which is never cut, unwound, or disturbed in any way after annealing, because the long round coils are wound directly onto the core by L-M's ingenious Round-Wound method.

"There's no patent on designing good regulation into a transformer," says Mr. Thompson. "The problem is to get good regulation *without* sacrificing other desirable characteristics, *and* without increased cost to the user.

"We are able to solve the problem with our wound core which is not cut, unwound or disturbed in any way after annealing, resulting in uniformly stable core loss and low exciting current. The compact cruciform cross section shape of the Round-Wound core enables the designer to use long round coils with fewer turns and smaller mean turn diameter, thus gaining lower resistance and reactance values. Uniformly low impedance with improved regulation at all power factors—both recognized features of real significance under today's operating conditions—are outstanding features of the Round-Wound transformer."

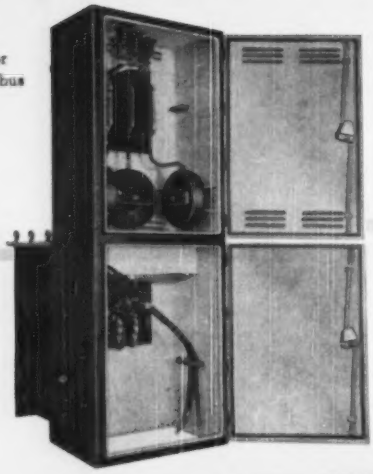
Want to know more about the savings "Round-Wounds" offer the utility company? Want to know more about how L-M Round-Wound transformers are designed, why they give "Balanced Performance" and operating benefits to the user, better service to the customer? Ask the L-M Field Engineer for this fact-packed bulletin No. 16-G-1, or **write Transformer Division, Line Material Co., Zanesville, Ohio.**

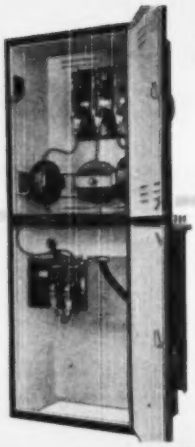
LINE MATERIAL Transformers

LM

Complete Coordinated Equipment For All Distribution Requirements

Arranged for self-contained bus



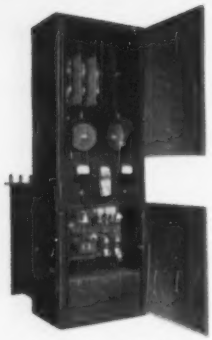


Standard Starter

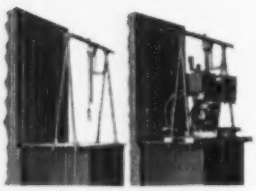
E C & M VALIMITOR Starters

give all the protection ever needed for 2300-4600 volt motors

Nothing to replace - - No change later on due to increase in KVA.



Synchronous Starter



Lifting mechanism available for raising contactor to the top of the tank. Unnecessary to disconnect any bolts or leads to lift contactor to this accessible location.

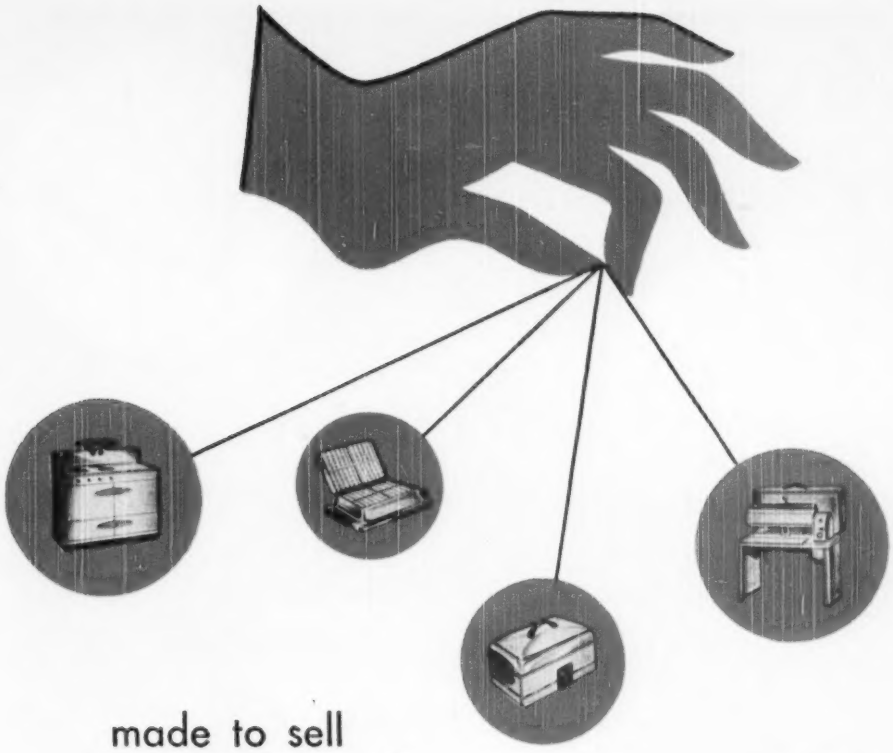
These advanced starters cannot be outmoded by an increase in KVA in the plant or from the power source. There's no need to worry about, *nor* even calculate, existing or probable future KVA. All the protection *ever needed* is built into these EC&M Starters.

An added advantage is *cushioned starting*—when the motor is up to speed, these starters function like any standard full voltage starter. Eliminate the risk of short circuit damage by installing EC&M VALIMITOR Starters.

Write for No. 23 ACCELERATOR Bulletin, giving complete description.

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79TH STREET ★ CLEVELAND 4, OHIO



made to sell
with **chromel**®

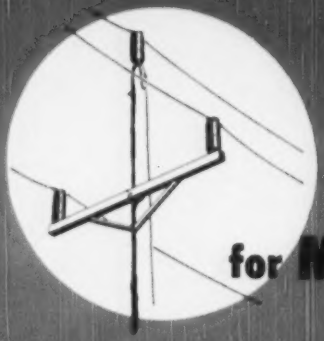
® the original nickel-chromium heating element wire

That's right. Durable CHROMEL Resistor Wire has had a lot to do with building sales of electrical heating devices . . . a lot to do, too, with building and maintaining your domestic and industrial heating loads. For CHROMEL, you know, is the *original* nickel-chromium resistor wire . . . the wire that *first* made electrical heating practical. Complete technical information on the CHROMEL family of alloys is contained in our Catalog M1 . . . want a copy?

Chromel®

HOSKINS MANUFACTURING COMPANY
4445 LAWTON AVE. • DETROIT 8, MICHIGAN

Don't Let OLD STANDARDS HOLD BACK PERFORMANCE



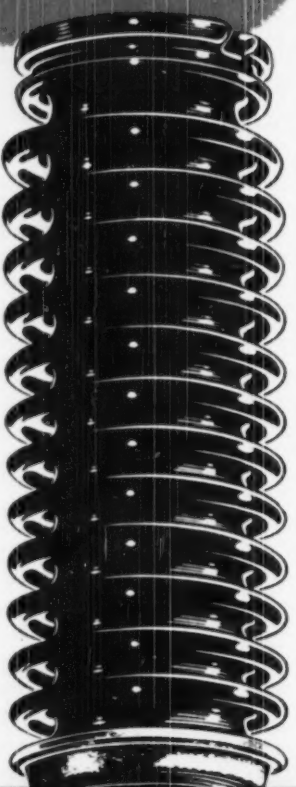
Now is the Time

to STANDARDIZE for MAXIMUM PERFORMANCE

IF you're one of the men who said, some eighteen years back: "Seems like a good idea—in theory" . . . well, sir, Lapp Line Posts have long since *proved* that they're the *best* idea . . . on hundreds of lines . . . for efficient performance.

- On installations which gave Lapp Line Posts their first trial on "trouble-spots": Lapp Line Post replacement rate is only 1% to 10% that of ordinary insulators *on the same lines.*
- 18 years of performance records prove . . . Flashover and mechanical attack which knock out ordinary insulators are absorbed by Lapp Line Post petticoats . . . body remains uncracked . . . insulator continues in fully effective service.
- Lapp Line Post Fog Type corrugation has eliminated cleaning from maintenance schedules—with full confidence of efficient performance.
- In every one of the hundreds of installations where performance records are kept on them, *lines on Lapp Line Posts have fewer outages, require fewer replacements and less maintenance than comparable lines on any other type of insulator.*

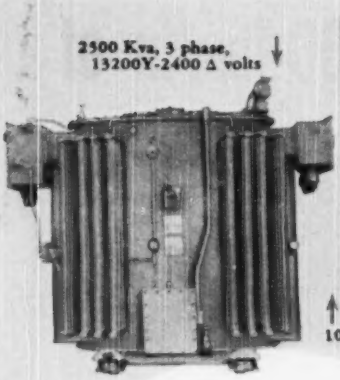
Proof that Lapp Line Posts give maximum performance . . . with maximum economy! It's a long time now since they were a "new-fangled idea." It's high time to consider whether you can any longer afford *not* to standardize on Lapp Line Posts for your own lines.



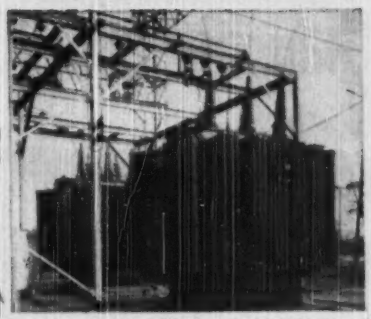
PERFORMANCE IS PROOF

Lapp INSULATORS

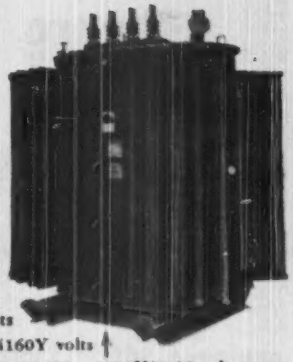
LAPP INSULATOR CO., INC. • LE ROY, N.Y., U. S. A.



2500 Kva, 3 phase, 13200Y-2400 Δ volts

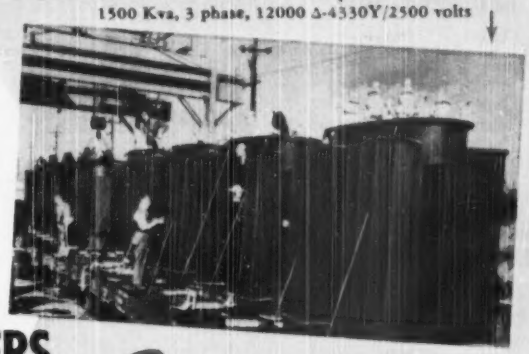


10000 Kva, 3 phase, 66000 Δ-12470Y/7200 volts



3750 Kva, 3 phase, 12000 Δ-2400 Δ/4160Y volts

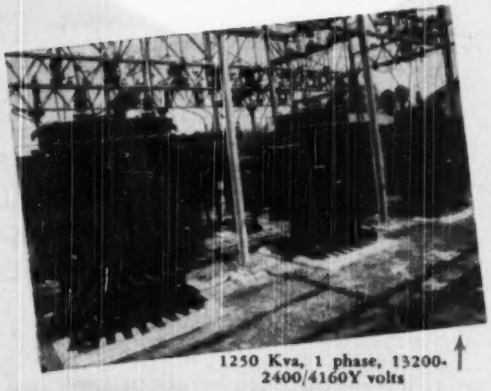
1500 Kva, 3 phase, 12000 Δ-4330Y/2500 volts



Others are SAVING UP TO 8% on their POWER TRANSFORMERS

So can you by specifying

PENNSYLVANIA STANDARD PARTS POWER TRANSFORMERS



1250 Kva, 1 phase, 13200-2400/4160Y volts

Here are some Standard Parts Power Transformers that have been manufactured in the Pennsylvania Plant and delivered to Utilities and Industrials in various parts of the country.

Because these are Standard Parts Transformers, they were purchased at considerable discounts — up to 8%.

It will pay you to find out about the PENNSYLVANIA Standard Parts Power Transformers and why they can be bought for less. We invite you to write for more information.

mail this coupon

Pennsylvania TRANSFORMER COMPANY
Canonsburg, Pennsylvania
Greater Pittsburgh District

PENNSYLVANIA TRANSFORMER COMPANY
Box 330, Canonsburg, Pa.

Please send me a copy of your Standard Parts Power Transformer Bulletin No. 1492.

Name _____ Title _____

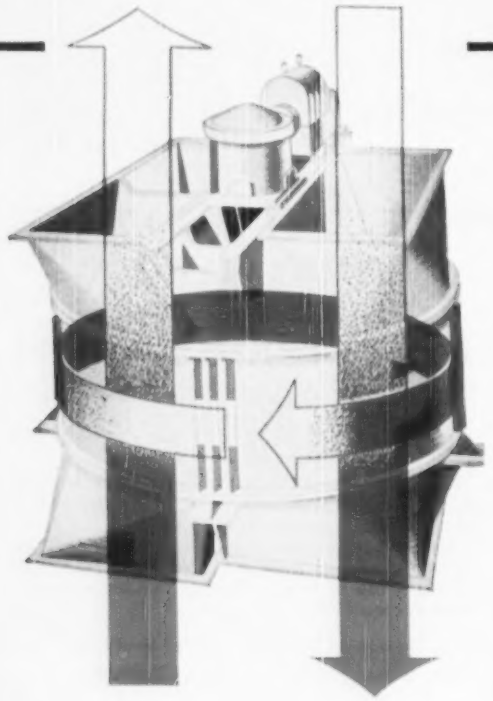
Company _____

Street _____

City _____ Zone _____ State _____

more than 160,000,000 lbs/hr of post-war steam generating capacity

equipped with *Ljungstrom*
AIR PREHEATERS



Here indeed is impressive evidence of the wide acceptance of the Ljungstrom air preheater. Since the war the total capacity of steam generating units equipped with Ljungstrom air preheaters, installed, under construction or on order in industrial and utility plants throughout the country comes to well over 160,000,000 lbs of steam per hr.

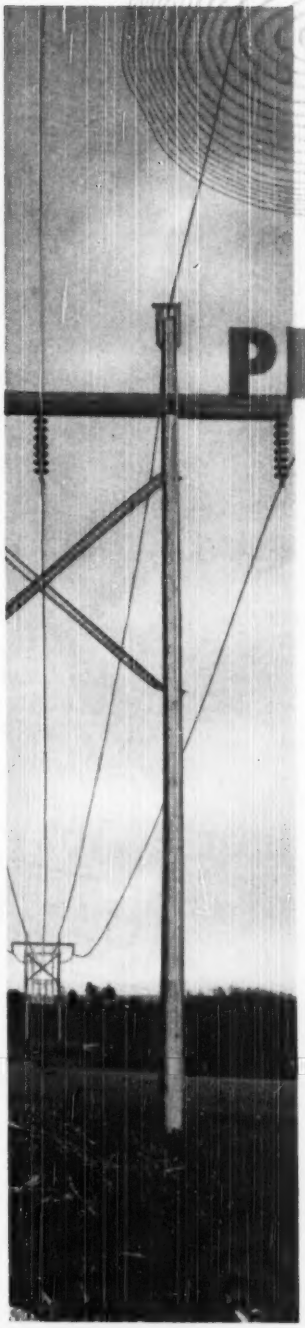
The reasons for the steadily increasing preference for the Ljungstrom air preheater are simple enough. The continuous regenerative counterflow principle assures maximum heat transfer with minimum weight and size. Flexible and compact, it may be used in a wide range of applications. Its proven reliability and low maintenance eliminate costly shutdowns.

If you are planning to build a new plant or modernize an old one, investigate the possibilities of the Ljungstrom. The specialized experience of Air Preheater engineers is at your disposal, to aid in effecting the most economic heat recovery from flue gases.

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

THE AIR PREHEATER CORPORATION
60 EAST 42d STREET • NEW YORK 17, NEW YORK

CLEAN, positive protection for crossarms and poles



PENTA CHLOROPHENOL preservative

(Santophen 20)

Monsanto Penta preservative goes deep into wood and *stays in*. That means long-lasting protection against decay and wood-destroying insects. It means long life for crossarms and poles. Monsanto Penta treatment is *clean*—improves appearance, makes wood easier to work around.

Since penta keeps crossarms, poles, braces and other treated members structurally sound, it means more protection for materials as well as *greater safety for workmen*. Penta does not increase the conductivity of wood.

If you'd like to know more about the advantages of penta protection, write for the booklets: "PENTA . . . the best protection for poles and crossarms" and "PENTA for preserving wood in industrial construction." A copy is yours for the asking. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1758-A South Second Street, St. Louis 4, Missouri.

Santophen: Reg. U. S. Pat. Off.

WHERE IT PAYS TO USE PENTA

Poles
Crossarms
Braces
Platforms and Decking
Loading Docks
Catwalks and Railings
Tool and Machinery Sheds
Trestles and Bridges
Guardrails
Flooring
Sills, Plates, Joists, Rafters and Roofing
Sash and Doors
Ladders and Stairs

MONSANTO
CHEMICALS—PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

MONSANTO CHEMICAL COMPANY
Organic Chemicals Division
1758-A South Second Street, St. Louis 4, Missouri

Please send . . . "PENTA . . . the best protection for poles and crossarms", . . . "PENTA for preserving wood in industrial construction."

Name . . . *Title* . . .

Company . . .

Street . . .

City . . . *Zone* . . . *State* . . .

SILICONE VARNISHED FIBERGLAS*

SILICONE VARNISHED FIBERGLAS* TUBING

SILICONE GLASS MICA

SILICONE COATED ASBESTOS

SILICONE RUBBER COATED FIBERGLAS*

SILASTIC** COATED FIBERGLAS*

IRVINGTON OFFERS THE COMPLETE LINE OF CLASS H FLEXIBLE INSULATION

Again Irvington leads the way . . . with the most complete line of Class "H" insulations obtainable. Now, manufacturers faced with high temperature problems can successfully meet each specific requirement from this broad line. Designers, too, faced with the need to design more compactly, or reduce weights, can select insulations exactly suited to their needs. These Irvington Class "H" insulations are furnished in many thicknesses, and widths up to 36". Complete information, and generous samples, gladly furnished on request.

"Look to Irvington
for continued leadership in insulation"

IRVINGTON
VARNISH & INSULATOR CO.
Irvington 11, New Jersey

*T. M. Reg. U. S. Pat. Off. by Owens Corning Fiberglas Corp.
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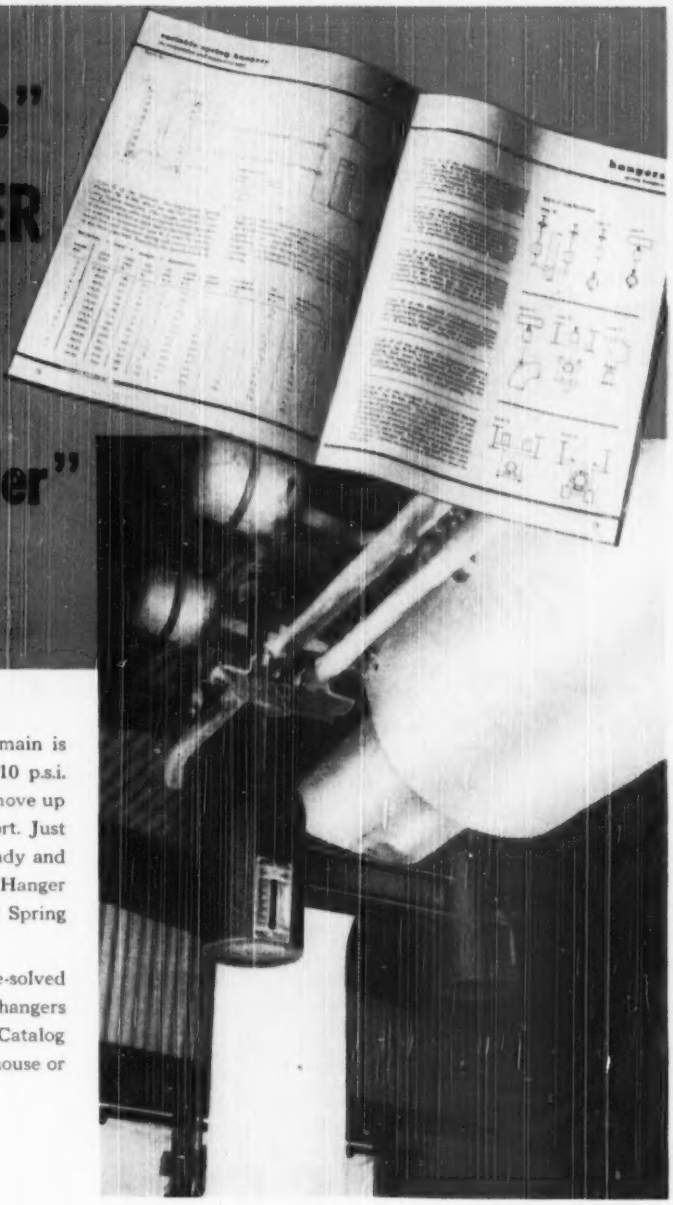
"Ready-made" PIPE HANGER for a "made-to-order" FIT



Look how closely this 8-inch steam main is tucked up under the roof. And, at 410 p.s.i. and 550°F., this piping was bound to move up and down enough to need flexible support. Just the hanger to fit this situation was ready and waiting right in the Grinnell Pipe Hanger Catalog 10-D . . . the Pre-Engineered Spring Hanger fig. B268, type G.

Every pipe suspension problem is pre-solved for you by Grinnell ready-to-install hangers and supports. You can get a copy of Catalog 10-D from your Grinnell branch warehouse or local Grinnell jobber.

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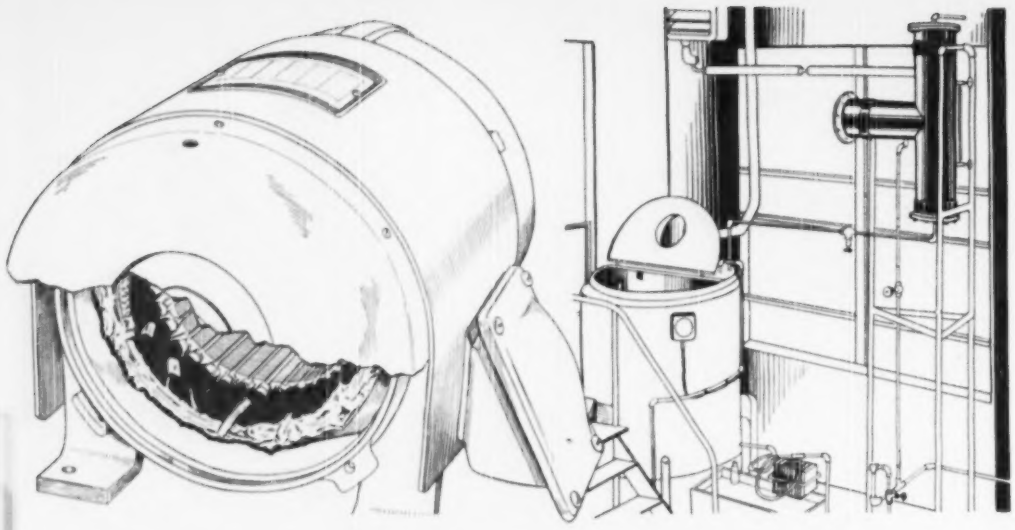


Why Reliance Electric is "Fussy" about Insulation

Consider how motors are used—in the high ambient temperatures of a steel mill; in the damaging fumes of a chemical plant; sometimes running steadily night and day.

That's the background for the punishment tests devised for BH "649" Fiberglas Tubing by Reliance Electric & Engineering Company.

They bent it . . . twisted it . . . soaked it . . . baked it. And when the punishment tests were over, they specified BH "649" Fiberglas Tubing for Reliance Precision-Built Motors.

BH "649" takes the roughest handling in assembly or service without impairing its electrical qualities, making it possible in many cases to drop one insulation grade and still maintain a generous margin of safety.

BH "649" is a superior Fiberglas insulation—at a price comparable to cotton. It is unaffected by moisture, oil, grease or ordinary chemicals.

BH "649" is available in Grades A-1, B-1, C-1 and C-2. In all sizes from No. 24 to $\frac{5}{8}$" inclusive. Try it on your tough insulation jobs.

BENTLEY, HARRIS MFG. CO., CONSHOHOCKEN, PA.

BH Fiberglas* SLEEVINGS

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2391530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

COUPON

Bentley, Harris Mfg. Co., Dept. W-39, Conshohocken, Pa.

I am interested in BH "649" Fiberglas Tubing and Sleeving. Send samples for production testing of Grade_____ in sizes as follows_____ (size or I.D.) for_____ (product) operating at temperatures of_____ °F. at_____ volts.

NAME _____

ADDRESS _____

Send samples, pamphlets and prices on other BH Products as follows:

☐ BH non-fraying Fiberglas Sleeving

☐ Cotton or Rayon-base Sleeving and Tubing

How to get a fire-extinguishing system FREE!

An auto manufacturer had a mean fire hazard in some automatic screw machines.

The job called for a light oil coolant. With its low flash point the oil frequently caught fire from heat generated by machining.

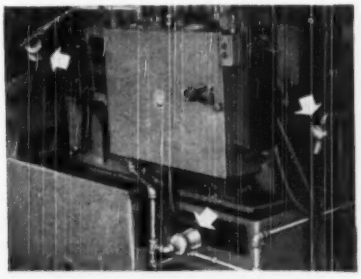
The extinguishers used by the company killed these repeated fires successfully. But the extinguisher chemical spoiled the coolant—left a mess on the machine. And downtime needed to clean the machine and replace oil after a fire was never less than 16 hours—often ran to 2 or 3 days.

Kidde extinguishing systems were installed on all these screw machines. They detect and kill fires automatically. The dry clean CO_2 discharged by the *Kidde* systems doesn't mess up the machine. It evaporates from the coolant oil, leaving no trace. After a fire, *downtime is 1 hour, no oil need be replaced.*

The *Kidde* systems cost $800 per machine. *The company says they paid for themselves in the first month!*

That's how our friends, the auto manufacturers, figure they got the *Kidde* installation free. You'd figure that way, too, wouldn't you?

If you want to know more about *how* such systems work, mail the coupon for literature.



Arrows show location of *Kidde* Multijet Nozzles through which CO_2 is discharged to kill fires starting on automatic screw machine during cutting operations. The CO_2 does the job fast—and clean.

Walter Kidde & Company, Inc.
130 Main Street, Belleville 9, N. J.

Gentlemen: Please send me descriptive literature on *Kidde* automatic extinguishing systems.

NAME.....

COMPANY.....

ADDRESS.....

CITY..... STATE.....

Kidde

Walter Kidde & Company, Inc., 130 Main Street, Belleville 9, N. J.
In Canada: Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

"'CSP' saved us $17,465.50 in our urban radial system"

So said this midwestern operator after installing 650 Completely Self-Protecting distribution transformers.

When the 2,400-volt radial feeders for urban and suburban areas outside the downtown network system became seriously overloaded, distribution voltages were stepped up to 7,960/13,800 volts wye.

Economically, the utility found this comparison of costs *beyond the price of the basic transformer:*

FOR CONVENTIONAL INSTALLATION		FOR "CSP"* INSTALLATION	
Arrester, installed	$30.00	Additional cost of "CSP" over the conventional transformer—includes built-in lightning and thermal protection plus load indicating light.	$34.13
Fuse mounting and fuse, installed	20.00		
Two 8 ft. crossarms, installed	12.00		
3 ft. crossarm, installed	4.00	Higher pole for secondary lead clearances	5.00
Total	$66.00	Total	$39.13

Simple arithmetic makes 650 "CSP" installations save $17,465.50. What's more, *real* protection from overload was secured—with semiautomatic load check as a bonus. Conventional transformers with fuse links could not supply this protection and still withstand lightning surges.

One thing you can be sure of: the built-in protection of "CSP" saves installation costs. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-70526

**Trademark—Reg. U. S. Pat. Off.*

HERE'S PROOF FROM U. S. A.—Thirty case histories of Completely Self-Protecting transformers, with names, dates, places, facts and figures. Get your copy of B-4248.

Call the Westinghouse Salesman

WESTINGHOUSE

Westinghouse "CSP" TRANSFORMERS

SINGLE PHASE THREE PHASE BANKED SECONDARY

Look closely into *all* the advantages of VARIAC VOLTAGE CONTROLS

- **EXCELLENT REGULATION** — less than ¾% at line voltage and less than ⅞% of line at ½ line voltage. There is very little change in output voltage under varying loads with the VARIAC®
- **TOROIDIAL CONSTRUCTION** — voltage change is directly proportional to dial rotation over the complete output range
- **MACHINE-WOUND COILS** — insure maximum uniformity in lay and tension of windings (and a toroidal winding machine for wire of these sizes is a neat machine to design!)
- **ADVANCED BRUSH CONSTRUCTION** — coil spring maintains uniform brush pressure under all conditions of brush wear; very low inertia of sprung weight in moving part results in less wear under vibration, and eliminates bounce; NO TOOLS needed to change brushes
- **READILY REMOVABLE SHAFT** — for reversing to table or panel mounting — requires no disassembly of radiators, collars, etc.
- **KEYED SHAFTS** — on larger models requiring greater torque, insure permanent line-up of shaft and radiator, especially important in ganging
- **NO PIGTAIL CONNECTIONS**
- **SAFE TERMINALS** — for either screw or solder connections — clearly marked in output voltages
- **PRESSURE CONTACTS** in the VARIAC do not depend upon mechanical properties of insulating materials

NO tools needed to change the VARIAC brush. A twist of the cartridge-like holder and it and the brush come out immediately.

For changing to behind-the-panel or to table mounting the brush, radiator, collar, etc. are not disturbed. Just the shaft, dial and knob, as a unit, are removed.

Moulded barriers between terminals eliminate possibility of short-circuits. Both screw and solder terminals provided. Voltages across terminals clearly indicated in moulded terminal board.

VARIACS are manufactured and sold in standard units or assemblies to control from 170 to 24,700 va. There is a VARIAC to fit almost any a-c voltage-control problem. Our engineering department will be glad to assist you in selecting the most suitable model.

*VARIAC *is a registered trade name*

Write for the new VARIAC BULLETIN

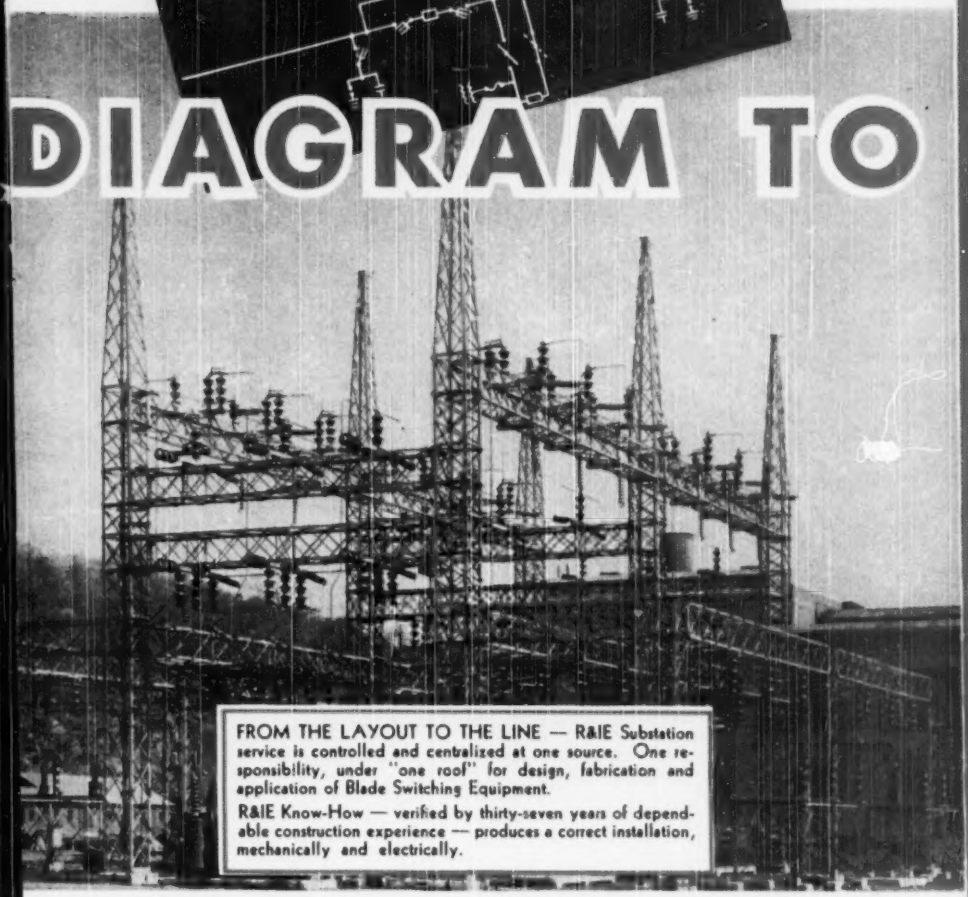
Organized in 1915, at Cambridge, General Radio has been engaged continuously in the design, manufacture and sale of precision electronic laboratory instruments and test equipment.
The G-R laboratories, factory and offices are housed in this 3-unit building with a floor space of 150,000 square feet. General Radio Company employs a total of 430 persons.
6

GENERAL RADIO COMPANY

Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38

DIAGRAM TO DELIVERY



FROM THE LAYOUT TO THE LINE — R&IE Substation service is controlled and centralized at one source. One responsibility, under "one roof" for design, fabrication and application of Blade Switching Equipment.

R&IE Know-How — verified by thirty-seven years of dependable construction experience — produces a correct installation, mechanically and electrically.

RAILWAY AND INDUSTRIAL ENGINEERING COMPANY, GREENSBURG, PA.

IN CANADA—EASTERN POWER DEVICES LIMITED, TORONTO

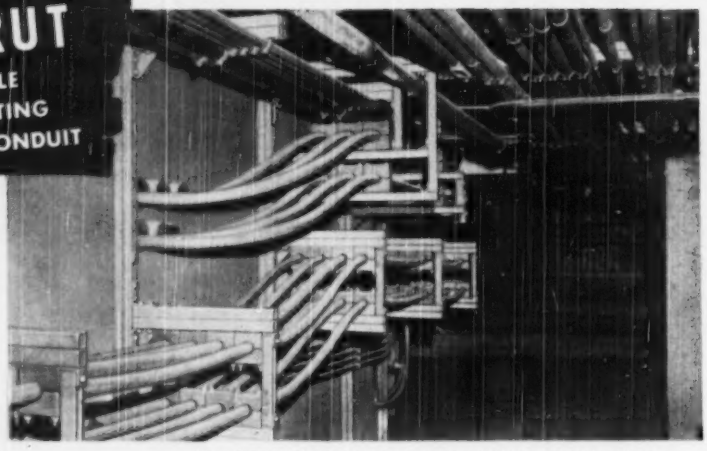
The Check List

- CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- DISTRIBUTION EQUIPMENT
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SWITCHING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

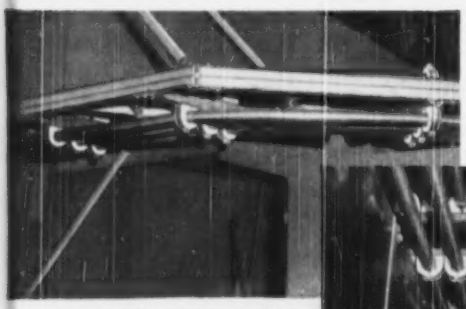
IOWA ELECTRIC LIGHT and POWER COMPANY

FINDS UNISTRUT THE MOST FLEXIBLE MEANS OF SUPPORTING HEAVY CABLE AND CONDUIT

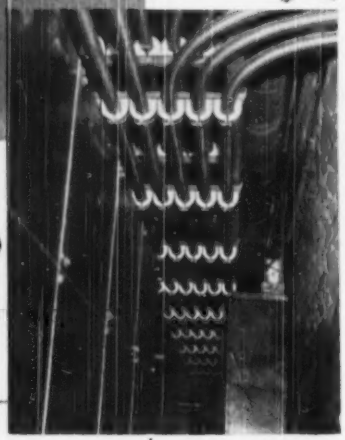
Like a giant Erector set, completely adjustable Unistrut simplifies the most difficult problems of supporting heavy cable and conduit used in distribution systems—permits fast, on-the-job framing assembly where all adjustments are easily made by just loosening a bolt, and supporting members added as work progresses. No drilling, no welding, no special tools or equipment—saves time, cuts costs. A trial of Unistrut on your next job will show you how much quicker, better and more economically the work can be done.



Notice Unistrut's trim steel framework. Note too the Unistrut porcelain and maple clamps that hold the heavy cable and conduit firmly in place.



An unusual bracing arrangement utilizes standard Unistrut channel and fittings in attaching the cable-supporting Unistrut framework to wall.



Rows of heavy armored cable are quickly installed and easily supported with completely adjustable Unistrut channel and porcelain cable clamps.

Write today for Free Sample of Unistrut and these catalogs:
Cat. 500: Construction Uses of Unistrut—supports, frames, mounts, etc.
Cat. 600: Materials Handling Uses of Unistrut—racks, bins, etc.

THIS IS UNISTRUT!

Unistrut is metal channel with a continuous slot. You simply insert the Unistrut spring nut into the channel at approximate point where attachment of another framing member is desired, slide to exact location and bolt to Unistrut fitting. Unistrut includes concrete inserts, pipe and cable clamps, roller pipe supports, brackets, and many other standard parts which in combination provide the world's most flexible system of support or suspension.

Unistrut is trim framework—provides great strength without bulk. It's easy to work with, lasts indefinitely, and the finished structure assures neat and orderly appearance. With it you can build practically everything—all types of framing, mounts, shelving, racks, tables and benches, cable, conduit, pipe and tubing hangers and supports, fluorescent fixture supports and many other structures with only a hacksaw and a wrench.

THE 3 QUICK UNISTRUT STEPS

1. Insert nut into channel
2. Locate fitting and nut
3. A turn of the wrench—it's done

Prompt delivery from Warehouse Stocks in Principal Cities. Consult your Classified Directory.

UNISTRUT PRODUCTS COMPANY
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Chicago 7, Illinois

UNISTRUT PRODUCTS CO.
1013 W. Washington Blvd., Chicago 7, Ill., Dept. W-1

Please send free sample of Unistrut and catalogs checked below without obligation.

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Company _____

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The World's Most Flexible All-Purpose Metal Framing

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For CONNECTORS and BUS SUPPORTS

Southern States' revised Connector and Bus Support Catalog can help make your selection of fittings a matter of moments. It lists and illustrates fittings for all normal requirements and is completely indexed and cross-indexed for easy reference. In addition, Southern States is equipped to design and manufacture fittings for any unusual requirements.

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This detailed 160-page handbook is
YOURS FOR THE ASKING!
8 full pages of technical information
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Your telephone uses ceramics, too!

Five thousand years ago, potters were making household vessels of clay. As skill grew, grace of shape and ornament were added. The beauty of fine china has been recognized by every civilization, while the availability, ease of manufacture and durability of other ceramics have given them wide use.

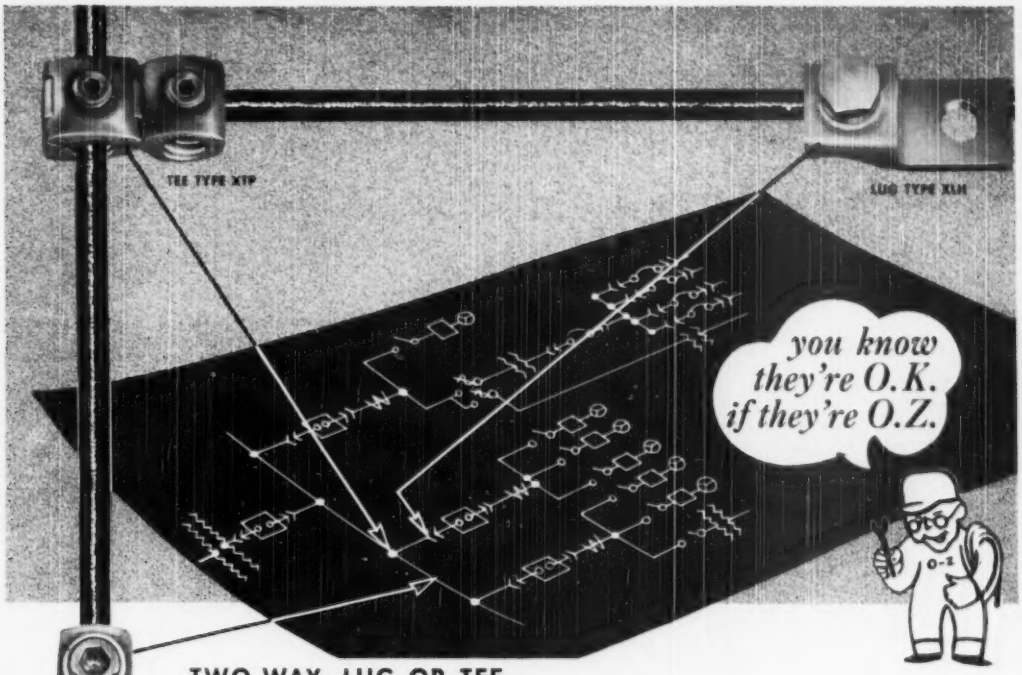
Your telephone, too, uses ceramics. Behind its dial is a metal plate, glazed as carefully and in much the same manner as this fine piece of pottery. It carries the letters and numbers you dial, so it must resist both fading and abrasion. You will find other ceramics as insulators, supporting wires on pole lines; in eighty thousand miles of underground conduit, where fired clays defy decay and corrosion.

Today at Bell Telephone Laboratories scientists utilize ceramics in ways undreamed of in ancient times. Thermistors, made of a ceramic, provide automatic controls for electric current, to offset fluctuations in temperature and voltage. One kind of ceramic makes low-loss insulation at high frequencies, while another supplies controlled attenuation for microwaves traveling in waveguides.

Each use demands a special composition, scientifically controlled and processed. Basic studies in the chemistry and physics of ceramics have shown how to utilize their versatile properties in electrical communication. And research continues on ceramic materials as well as on every other material which promises better and cheaper telephone service.

BELL TELEPHONE LABORATORIES

EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE.



TWO-WAY, LUG OR TEE . . .

GET PERMANENT CONNECTIONS WITH ALL THREE . . .

TWO-WAY TYPE XW

Whenever you're tapping, butting, terminating, put in **O.Z.** solderless connectors—then you're sure of permanent connections . . . *always*. There's a solderless connector in O. Z.'s complete line of thirty different types that will assure you fast, easy installation—as well as positive, strong connections—on any wire in any of the wide range of sizes used in building installations. Here are a few of the features that make O. Z. solderless connectors outstanding:

Tin-plated spring steel lock washers that hold their resiliency, maintain pressure—permanently.

Serrated pressure plates that give maximum bite for positive grip.

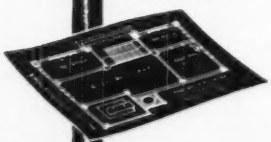
Highly conductive copper alloy body that is acid dipped to assure low resistance contact.

Extra strong copper alloy bolts and hinged parts that guarantee strong contacts, give lasting mechanical strength.

Simplicity of one-piece construction for speed of assembly—no parts to lose.

Ask nothing less than permanency of the connectors you use! Ask your distributor for O. Z. solderless connectors. He can supply an O. Z. connector for every type of application. He also carries a full line of O. Z. Insulated Bushings, End Fittings, and Split Couplings—equally unmatched for performance!

All types of O. Z. solderless connectors are satisfactory for aluminum building wire if ordered with the special Codux plating.



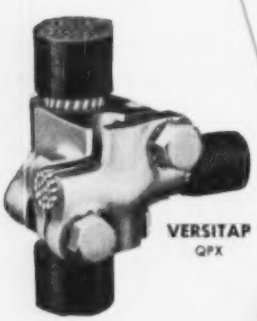
3698

CONDUIT FITTINGS
SOLDERLESS CONNECTORS
CABLE TERMINATORS
CAST IRON BOXES
POWER CONNECTORS
GROUNDING DEVICES

O.Z. ELECTRICAL MANUFACTURING COMPANY

262 BOND STREET · BROOKLYN 2, N. Y.

You're Well Connected with BURNDY



VERSITAP
QPX

QIKLUG
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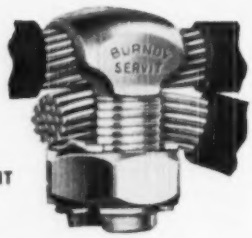

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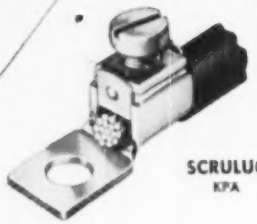
HERE'S WHY

OKLIP
KVS



SCRULUG
KPA

They're designed with *you* in mind. Each connector, whether it be a tap, terminal or splice, is especially engineered for its specific job. Without fuss or fumble, each Burndy connector is installed quickly and simply. With a few sizes and types you can do almost any connecting job.

Because they are easier to work with and because they are both mechanically and electrically superior, Burndy connectors are preferred among contractors and industrial maintenance men. Catalog 52 completely describes Burndy connectors. You'll find it handy, so send for a copy today. When you're on the job, *connect with Burndy.*

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and HYLINK

Connect with
BURNDY

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Western Branch: Vernon 11, California • Canada: BURNDY CANADA, LTD., Toronto 8

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Here's Better Protection
for Low-Voltage Circuits

The NEW "DB"

It's a completely new breaker, designed for severe, continuous duty as the protective link between the power source and your productive equipment. Its many features are all planned to provide minimum maintenance throughout a long operating life:

New Overcurrent Tripping Device—Hermetically-sealed overcurrent trip provides time-delay on overloads, plus instantaneous tripping on fault currents. Short time-delay characteristics on fault currents for selective tripping when specified.

All-Metal Mounting Base—Provides a strong, rigid foundation for all parts.

Unit Construction—All attachments and parts easily removed as a unit.

"De-ion" Arc Interruption—For quick arc extinction . . . longer contact life.

Easier Installation—Smaller size . . . easier to work around. Free standing when unmounted.

Long Operating Life—Moving and wearing parts of hardened stainless steel. J-60719

Here's COMPLETE Information

Get answers to your questions, plus complete, detailed information from the new DB Breaker Book. Ask your Westinghouse representative or distributor for your copy of B-4067, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

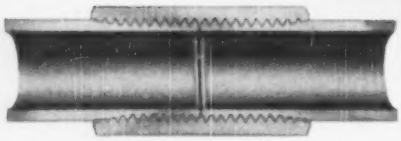
Westinghouse

"DE-ION" CIRCUIT BREAKERS
New Type DB

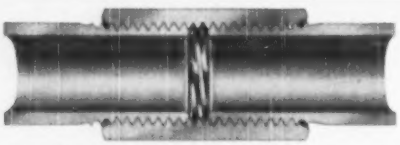
IT'S FORTIFIED FOR LIFE-TIME PROTECTION

SPECIFY NATIONAL ELECTRIC SHERARDUCT

To Keep Wiring Safe, PERMANENTLY



SHERARDUCT COUPLING—All surfaces and threads are Sherardized. Accurately undercut threads permit completely closed joints—no raw threads exposed—no gaps to interfere with the easy fishing of wires.



ORDINARY COUPLING—Raw threads meet raw threads—accelerates rust—weakens joint. Threads exposed in gaps trap wire ends and make the fishing of wires difficult.

FULL WEIGHT . . .

THREADED . . .

RIGID STEEL CONDUIT

When the job calls for a conduit that must withstand the test of time—there's only one *Sherarduct!* Sherarduct is a rigid steel conduit that is permanently rust-proof. The zinc protective coating alloyed to the steel by the special Sherardizing process will not crack or peel. Sherarduct is heavy-walled, threaded, smooth inside to assure easy fishing.

NATIONAL ELECTRIC PRODUCTS — NE — WIRING SYSTEMS 6 WIRES AND CABLES

National Electric
PRODUCTS CORPORATION

1305 CHAMBER OF COMMERCE BLDG., PITTSBURGH 19, PA.

The People Vote "No"

IN 1949 Congress voted the record amount of $1.7 billion for power and power-related agencies. In doing so, it approved funds for TVA's New Johnsonville steam generating plant and gave the Southwestern Power Administration authorization for construction of additional transmission facilities.

Such sweeping appropriations would, it might seem, be in accordance with the wishes of the voting public. But, alas, there is no relation between the funds voted and the wishes of a majority of the adult population. In fact, recent surveys indicate that there is substantial opposition to Federal power expansion in the U. S. today. It almost seems that the only voters who want it are those who can profit from it at the expense of other taxpayers.

Substantiating these conclusions is the year-end study of George Gallup. He found that only 24% of the people think that the U. S. government should own the electric power companies. There were 58% who gave a definite "no" in answer to the question. This report is even more noteworthy when considered in comparison with the 40% whom he found wanted to nationalize electric power companies in 1936, at the peak of Roosevelt's efforts in this direction. But the majority was opposed.

In spite of this trend in public thinking, the legislative branch of the government continues to promote further expansion of public power. In fact, the present balance between public and private power generating capacity—20% versus 80%—is destined to tilt in a direction approved by only 24% of the adults in the country. The gains made in 1949 could be important steps down the ladder toward socialization.

Furtherance of this trend, clearly provided for in the American Public Power Association's federal power policy, does not depend upon significant changes in legislative policy. The obvious end can come through the installation of a vast transmission network coupled with steam and hydro generating stations subsidized by the federal government. The takeover of local distribution systems would logically and inevitably be the next step.

Unfortunately, we must look at the possible ultimate consequences of the recent Congressional actions in order to maintain a perspective on tomorrow's dangers. This same picture must be impressed upon the legislative representatives who would vote for more federal transmission, a CVA and MVA, in spite of a following of only 24% of the voters.

If the percentage of the people who desire nationalization of the electric power companies can be brought down from 40% to 24% in 13 years, those favoring such an idea can be reduced an equal percentage in a future period of similar length. Such a gain will still be inadequate. To completely win the battle, the percentage against nationalization should be increased from 58% to 100%. The Congressmen who now vote in opposition to the will of the majority must be defeated in future elections.

Ten Little Free Workers

"Ten little free workers in this country fine and fair.
But if you cherish your freedom—worker have a care!
Ten little free workers—Reddy was doing fine
Until the socialists got him—then there were nine."

This is the opening stanza of the most popular piece of literature supporting free enterprise that has ever been published. Called "The Story of Ten Little Free Workers," it is being run as an advertisement (see p 46) by electric utilities, manufacturers, and trade associations the length and breadth of the land.

Some will scoff at our calling an advertisement literature. It lacks the dull, dry data that have made the public ignore the story of free enterprise as told by electric utilities. It may even be called childish—This is only natural as its mother was a nursery rhyme.

But this advertisement, written by the advertising manager of a small utility, does something no other piece of writing has done so far. It explains the dangers facing free enterprise in terms of ten industries and professions, hundreds of different occupations, and of over two thirds of all persons employed in the United States.

This ad is a message to the worker and the housewife in terms they can understand. It is a rhyme that will educate the children. It is the story of the menace of government ownership and the welfare state that electric utilities should publicize.

Rational Station Costs

THERE WAS a time when divulged costs per kilowatt of new power plants were reasonably comparable. Differences were due to local factors, and the variances in design accounted for the spread in values because the habit was to express the dollars in terms of turbogenerator *ratings*. But the scarcity of capacity has ruined whatever comparability there used to be. It was learned that ratings were nominal and that capabilities were more significant indexes.

Now there exists considerable chaos because at least four bases are being used to divide the overall cost of a plant to derive its unit cost. One system takes the maximum capability, another the net capability, a third the machine rating, and a fourth even uses the kva.

Naturally there will be an even wider percentage spread than used to prevail because the divisor quite consistently used to be the rated kilowatts. When one hears of a plant today costing $110 and another over $200 one immediately queries the arithmetic.

There should be but one way to express unit cost of a power plant. Otherwise the situation is as incongruous as it was when phenomenally low costs claimed for rural lines came to be understood when it was admitted that the farmers supplied the men, the oxen, the poles, and the pole holes. The turbogenerator maker provides the unit with a conventional rating plus a conjectural amount of extra capability—that leads to maximum capability. He does not, however, contract to supply the energy consumed by the auxiliaries—that leads to net capability.

Ratings are a bit arbitrary, excess ability is arguable, auxiliary consumption is variable, and kva is probably indefensible. But among or between them must be a defensible basis. It needs to be established. Then those who design (and perform) at low cost can expect to be called on to explain how they do it and those who spend twice as much will probably be able to explain (when they are asked "how come")—all in the same clear and logical language.

Have Another Round?

AS AN INDUSTRY, utilities are neglecting the bartender shamefully! No, we are not suggesting that utility folks spend more money in bars—quite the contrary. But we are suggesting that the bartender is a citizen who deserves more attention from the industry than he's been getting.

Occasionally of late some of the more progressive companies have been organizing plant visits for teachers, preachers, local political leaders, and major stock holders —"thought leaders you know"—to show them the inner doings of free enterprise at work.

This is an altogether laudable activity and one we heartily endorse as far as it goes. But it occurred to us the other evening that thought leaders after all fall into two classifications, those who mold opinion—the teacher-preacher group—and those who preside over its distribution. And it's to this group, along with the press and radio, that our friend Riley, the bartender, belongs. For sheer volume of opinion that passes over it, nothing is the equal of a bar, not even ten tables of Canasta on Saturday night.

But when it comes to dedications, inspection trips, and such, the bartender thought-distributor never gets to go. Yet in an eight hour shift he probably hears more acid comment from salesmen, clerks, and coal heavers about the practitioners of laissez faire capitalism than Joe Stalin on May Day.

To one and all the bartender offers a ready forum and an audience usually well conditioned to receive the seeds of mis-information and mistrust. In the midst he stands in shirt sleeves and apron, interlocuter extraordinary whose end men are optimists, fools, agnostics, pessimists, sore heads, wise men, agitators, and parlor pinks. To each the bartender, practical, everyday psychologist that he is, gives encouragement, advice, flattery, or the back of his hand as need requires.

Successful indeed and proud can that industry or company count itself that earns and holds the respect and support of such as he, philosopher, thought leader, and counselor to the passing parade.

The Electrical Week

Electric companies published many advertisements in 1949, but one stood out like the Empire State Building in a small town. This ad prepared by the Potomac Edison Co is being circulated nationally by utilities, manufacturers, and trade groups that want to tell the story of the dangers facing free enterprise in the U. S. . . . Southwestern Power Administration is getting together with business-managed companies in its area. Two utilities have already signed wheeling agreements, but still unconfirmed is the rumor that their deal isn't as good as the one made by Texas Power & Light Co . . . Advocates of private ownership of electric utilities were shocked last week when American Power & Light asked permission of SEC to sell its common interest in Pacific Power & Light Co to an investment syndicate. Eventual disposition of the stock would be to public utility districts. But aroused proponents of free enterprise are already at work on a counter-proposal . . . The President has delivered his annual budget message. He asked for no money for new public power projects, but all agencies are to get more money for the work that they are now doing . . . And TVA reports fiscal 1949 was a year of greater revenue and operations.

A three-man engineering advisory committee will help AEC plan and develop its reactor testing station near Arco, Idaho. Committee members are Gen L. J. Sverdrup, president of Sverdrup & Parcel, Inc, St. Louis consulting engineers, chairman; Dr H. M. Crothers, vice-president and dean of engineering, South Dakota State College; and W. W. Horner, partner in the engineering consulting firm of Horner & Shifrin, St. Louis.

Some sort of record for far-flung power operations was set Dec 28 by the Economic Cooperation Administration, which announced two new power programs totaling more than 100,000 kw and more than $12 million in ECA money. ECA will chip in $6,558,000 toward a $10,038,000, 50,000-kw steam plant near Venice, Italy; another $6.3 million from ECA will go toward cost of two steam plants and a hydro project to add 59,000 kw capacity in the Republic of Korea.

Newest rainmaking scheme may get some support from Congress. The method, seeding clouds with silver iodide particles, would work only during natural rain but is claimed to increase precipitation. Chairman Joseph C. O'Mahoney of the Senate Interior Committee may include funds for Interior to investigate this process in a bill he's pushing. Also in the bill: Funds for studying methods of turning seawater into fresh.

More than 2.4 million television receivers were produced during the first 11 months of 1949, the Radio Manufacturers Association estimates. This compares with an estimated total TV receiver production of 3.5 million since the war. With about 9 million radio and or TV units produced up to Dec 1, Association expects year's figures to show new record for radio-television industry.

REA's loan approvals passed the $2 billion mark Jan 10 when Administrator Wickard okayed $1,075,000 for the James Valley Electric Cooperative, Edgeley, N. D. REA has now approved loans totaling $2,000,354,707 since it opened shop in May, 1935.

Generation and transmission co-ops are taking more and more of REA's loan funds. Since mid-September, loans of $62,977,000 have been approved for seven "g and t" co-ops in a total of $109,143,000 approved by REA in that period.

A $13,299,000 Bureau of Reclamation project in the area of Grand Junction, Colo., would produce 51.6 million kwhr of firm power and 6,670,000 kwhr of secondary power annually at two plants, according to a new planning report. The report is on the proposed Collbran project on tributaries of the Colorado River.

Notes From The News

The Knoxville (Tenn.) Journal is asking that the President order TVA to distribute 425,000 tons of coal at its idle Watts Bar steam plant. The paper claims the coal will assist industry to keep operating . . . An experiment by the Louisville Gas & Electric Co in transporting coal to its plants by river barge had one effect. The railroads reduced freight rates 47c a ton . . . Supt. E. R. Hoffman of Seattle City Light wants a substation near the King County Airport insured for $11 million. The airport is used by large commercial and military planes. Recently a plane crash caused considerable damage in the neighborhood . . . New York City is placing new restrictions on installation of air conditioners. From now on installations using more than 6 gal of water a minute must use recirculated water . . . The Indiana Electric Association has given $10,000 to the Purdue University Agricultural Experiment Station for research in rural electrification.

Potomac Edison Produces Ad of Year

Advertising Manager Charles D. Lyon's Parody of "Ten Little Indians" Makes Man in the Street Aware of the Dangers Facing Free Enterprise

WHEN 31 electric utilities and 20 other companies and groups ask permission to reproduce an advertisement, when many others simply reproduce it without permission, and when the Electric Companies Advertising Program adopts the ad for its own use, it can be called the ad of the year.

For 1949 this designation goes to "The Story of Ten Little Free Workers." This advertisement was written originally for the Potomac Edison Co, Hagerstown, Md. Though this company with its subsidiaries serves only some 120,000 customers, it is a fighter for free enterprise.

Planned for Local Use

The man who wrote the copy, Charles D. Lyon, advertising manager of Potomac Edison, says that there was no intention of producing an ad suitable for use throughout the nation. It was prepared to be a good advertisement for company use only, but it was to be a good ad.

"The advertisement," Lyon says, "was not in any sense of the word a product of a brainstorm or sudden inspiration. We set out to develop an ad with several very specific requirements in mind. The first of these was that it should be simple and easily understood by any reader. Second, we wanted something that would tell the story of Creeping Socialism in familiar terms. Third, we were looking for something that would identify the interests of the utility companies with other types of business.

Seeks Outside Cooperation

"We feel very strongly that so long as the utility companies continue to fight an isolated battle, they are not going to get very much public interest or sympathy, and deservedly so; but if people can be made aware of the fact that utilities are presently fighting a battle which will eventually be everybody's, we stand a good chance of getting support and interest of other groups. Certainly our experience with this ad would tend to confirm that belief."

Lyon found the solution in an old nursery rhyme, "Ten Little Indians." Using this as a base and after considerable discussion with his associates, he then was ready to call in Daniel H. Fahrney.

THE STORY OF
TEN LITTLE FREE WORKERS
THESE ARE THE WORKERS
REDDY DOCTOR RAILROADER MINER STEELWORKER FARMER LAWYER GROCER SALESCLERK REPORTER
Ten little free workers in this country fine and fair.
But if you cherish your freedom—worker have a care!
Ten little free workers—Reddy was doing fine
Until the socialists got him—then there were nine.
Nine little free workers laughed at Reddy's fate
Along came federal medicine—then there were eight.
Eight little free workers thought this country heaven
But the government took over the railroads, then there were seven.
Seven little free workers—'till the miners got in a fix.
Uncle said coal's essential and took over leaving six.
Six little free workers 'till the day did arrive
The steel mills too were federalized—then there were five.
Five little free workers—h it the farmers are free no more
The farms have been collectivized—that leaves only four.
Four little free workers til the government did decree
All must have free legal advice—then there were three.
Three little free workers—the number is getting few,
But with government groceries selling food—then there were two.
Two little free workers—our story's almost done.
With clerks at work in federal stores—that leaves only one.
One little free worker—the reporter son-of-a-gun
Mustn't criticize government—so now there are none.
Ten little workers—but they are no longer free
They work when and where ordered, and at a fixed rate you see.
And it all could have been prevented if they'd only seen fit to agree
And work together instead of saying "it never can happen to me!"
THE POTOMAC EDISON COMPANY

THIS IS the advertisement that is warning the public of the dangers facing them

CREATORS of Potomac Edison's nation-sweeping advertisement boosting free enterprise confer. At left is D. H. Fahrney, who prepared the art; at right is C. D. Lyon who wrote copy

He produced the art work and layout.

The ad first appeared in July in newspapers in the company's area and as a bill enclosure. It was not long before requests for permission to reprint began coming in. They are still coming. Electric utilities from as far north as Massachusetts, as far east as New Jersey, as far south as Texas, and as far west as Idaho have used the ad. Associations such as the American Medical Association, the National Association of Manufacturers, and the Texas Manufacturers Association are using it. Even electrical manufacturers such as General Electric Co, Emerson Electric Manufacturing Co, and A. B. Chance Co are spreading the gospel of free enterprise through the medium of this ad.

As for Lyon, who is known nationwide among electric utility advertising men (he is secretary of the Public Utilities Advertising Association), he is somewhat astounded by the result. He admits it is the most popular ad he has ever written.

His compensation is best expressed in a letter from an advertising colleague. "I hope that you will feel compensated in having struck such a telling blow for free enterprise." He does and adds this comment:

"Aside from the interest that it has aroused among other companies and organizations, one of the most gratifying phases of its effectiveness is the number of personal comments we have received from individuals and requests for reprints for individual distribution. I say this has been particularly gratifying because it seems to indicate that the ad is reaching the man or woman on the street as well as business organizations."

High Court Backs FPC Control of Interstate Gas

Federal Power Commission appears to have won another jurisdictional scrap with state regulatory bodies—this time in the natural gas field. On Jan 9, the Supreme Court affirmed FPC's jurisdiction over natural gas distributors selling interstate gas in a single state. This decision was in keeping with previous ones concerning power transmission.

The 5-2 decision permits FPC to regulate the East Ohio Gas Company of Cleveland.

The majority opinion by Justice Hugo L. Black said:

"We find no language in the (Natural Gas) Act indicating that Congress meant to create an exception for every company transporting interstate gas in only one state.

"Regardless of whether it might have been wiser and more farseeing statesmanship for Congress to have made such an exception, we should not do so through the interpretative process. There is nothing in the legislative history which authorizes us to interpret away the plain Congressional mandate."

The Supreme Court ruling reversed findings of the District of Columbia Court of Appeals, which had held that East Ohio was not "engaged in the transportation of gas in interstate commerce within the meaning of the Act."

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Pay Schedule Changed

Employees of the Mississippi Power & Light Co are to be paid every two weeks instead of semi-monthly.

Oklahoma Utilities, SPA Sign 'Broad' Agreement

Southwestern Power Administration's contract with two Oklahoma utility companies—the first outside Texas to come to terms on power interchange with the federal agency—awaited Interior Secretary Chapman's signature in Washington this week.

SPA Administrator Douglas G. Wright announced in Tulsa last week that he had agreed on a joint contract with Public Service Co of Oklahoma and Oklahoma Gas & Electric Co. He took the agreement to the nation's capital this week. Secretary Chapman, whose signature is required to complete the contract, was expected to approve, Washington sources advised.

No details of the contract were disclosed, beyond Wright's assertion that it "is a very broad contract." It was understood, however, that the pact provided for sales of federal hydroelectric energy by SPA to the two companies. In return, the companies would permit the agency to use their facilities to deliver power to customers of the government. The companies apparently won none of the protective provisions contained in the contract now in force between the Texas Power & Light Co and SPA.

Company officials have not commented, either on the negotiations or on the agreement itself. A statement is expected later.

Wright also expressed optimism in regard to continuing negotiations with other power companies in the area. And it was reported that his agency soon would sign an agreement similar to that made with the Oklahoma utilities with the Southwestern Gas & Electric Co for power from the Narrows Dam, now under construction (EW, Dec 17, p 77).

Other negotiations are being carried on with utilities in Missouri, Kansas, and Arkansas.

New Dateline for EW

ELECTRICAL WORLD **is now appearing with a Monday instead of a Saturday dateline. Under the new policy all news is written with the assumption that it will reach the reader on the date printed on the cover. Another step to better service was taken late last year when EW secured the same handling for its mail circulation as the Post Office Department accords daily newspapers.**

Sale of Pacific P&L Viewed as End of Private Companies in Northwest

PROPOSED SALE of the Pacific Power & Light Co rocked the electric utility industry last week (Jan 5).

Plans of American Power & Light Co to sell all of PP&L's common stock to an investment syndicate was viewed throughout the industry as a decisive break in the virtually deadlocked private-public power battle in the Pacific Northwest. It was a break for public power, since the syndicate proposed to sell PP&L's properties in Oregon and Washington to "local groups," chiefly public utility districts.

$10 Million "Base Price"

In an application asking the Securities and Exchange Commission to approve the sale as part of American's dissolution under the Holding Company Act, the parent company reported it would receive a "base price" of $10 million cash for PP&L's common. An additional sum, up to $9.5 million, contingent upon sales of portions of the PP&L system, would be paid later by the syndicate.

The purchasing group was headed by the New York firm of B. J. Van Ingen & Co. Other members included John Nuveen & Co, Chicago; A. C. Allyn & Co, Chicago; Bear, Stearns & Co, New York; American Securities Corp, New York; Marianna Securities Corp, Chicago; C. S. Mott, an individual; Stifel, Nicolaus & Co, St. Louis; Robinson-Humphrey Co, Atlanta; Foster & Marshall, Seattle; Hartley Rogers & Co, Seattle, and Allegheny Corp, New York.

Myers Holds Option

One of the promoters of the deal, Guy C. Myers, was revealed by Howard L. Aller, president of American, as holding an option for an interest in the purchase. Myers previously had been prominent, as had Aller, in acquisitions by public bodies of power company properties in Nebraska. Myers for the past several years has been identified with promotion of PUD negotiations in the Northwest, particularly with efforts to take over properties of Puget Sound Power & Light Co.

Consummation of the proposed sale now hinges upon the verdict of SEC, which has set Jan 23 as the date of a hearing in Washington, D. C. Though the Commission had received no formal protests early this week, it was expected to hear from a number of groups before Jan 20, the deadline for applications to participate in the hearing.

Counter Bid Coming

An alternate bid for the purchase of Pacific Power & Light Co's common stock will be submitted to the Securities and Exchange Commission. The bid, if it is accepted as a substitute for the Aller-Guy Myers deal, will preserve private management of the utility.

Though the new purchase offer had not materialized at the time this issue of *EW* went to press, there was substantial evidence that it would do so shortly. Financial and utility sources predicted its announcement momentarily.

Among the organizers of the counter-proposal are reported to be officials of several Northwest power companies and other business interests of the area. No further details were available.

One state commission—Oregon's—already had announced opposition to the deal. Power companies of the Northwest, including PP&L's operating management, appeared likely to intervene, as did other local organizations.

That PP&L officers were caught by surprise as much as the rest of the industry was indicated in the brief announcement by Pacific President Paul B. McKee in Portland. It said, in part:

"I have no information about the proposed sale beyond that contained in the announcement from New York . . . The officers and directors of Pacific Power & Light have not been consulted on whatever negotiations have taken place between American, the holding company, and the proposed purchasers."

From other industry sources came angry comments to the effect that the sale would jeopardize the position of private power throughout the Northwest.

Basis of this complaint was a contention that the PP&L system, extending roughly northeastward from Portland to Washington's Yakima Valley, constituted a key bastion of private power in its battle with public ownership. These critics pointed to predictions by jubilant PUD officials that their takeover of the PP&L system would be followed quickly by acquisition of Puget Sound Power & Light Co and Washington Water Power Co.

But Aller denied that American was negotiating a sale of Washington Water Power, which also is a wholly owned subsidiary of the New York company.

"There are no negotiations concerning Washington Water Power," he said. "I have not even talked about such a sale since last July when I was asked if an offer would be entertained. I refused to discuss the matter on that basis and have heard nothing further since."

Acknowledging the opposition of PP&L's operating management to the deal, Aller defended it as the "only logical step" open to American "at this time." He said that SEC was pressing American to complete its reorganization and that the Commission had rejected a proposal that the holding company retain its two Northwest companies on a permanent basis.

An earlier effort to merge the two companies through contribution of PP&L's stock to Washington Water Power had been rejected by the Washington State commission, he added. And, "it is not logical today" to attempt sale of the two companies to American's stockholders.

"I am as strongly in favor of private enterprise as anyone else," Aller told ELECTRICAL WORLD, "but the forces of public ownership in the Northwest are great. And American Power & Light cannot stay its dissolution while the situation in the Northwest is being resolved."

Industry sources scouted the contention that American was under special compulsion to divest itself of its Northwest properties, however. And they contended that the proposed merger of PP&L and Washington Water Power was rejected largely because of the "absence of a definitive plan" by American for disposal of its common stock of Washington Water Power. American, it was charged, had made no subsequent effort to meet this objection or to develop any other plan for continuance of private management of the companies.

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Seattle Allots Funds

Seattle Municipal Board of Public Works has appropriated $3,554,000 for development work at the Gorge powerhouse on the Skagit River. The money will be spent for new work remaining after completion of the main contracts, new and replacement equipment, contract work running over estimates, and additional repair and construction items.

Truman Budgets Increased Funds for Public Power, No New Projects

THERE WILL be more funds for federal power in fiscal 1951 than in the present year if President Truman has his way. In his $42.4-billion budget, the President has asked for $2.2 billion for "natural resources." This category includes most power projects including all phases of atomic energy.

Though the big federal dam builders and operators, the Bureau of Reclamation and Corps of Engineers, will not start any construction during fiscal '51, which begins July 1, existing projects will require much larger increases in expenditures over the current year. Both received record high appropriations from the first session of the 81st Congress.

Interior power marketing agencies, Tennessee Valley Authority, and federal power regulating agencies are also listed for appropriation boosts.

Seaway Is Exception

Exception to the rule of no new big projects is a $6-million appropriation for the Corps of Engineers for the St. Lawrence Seaway. Although termed "navigation," the project if approved by Congress will include power development.

No money is allotted to either a Columbia Valley Authority or federal power projects in New England, both of which were boosted in the President's state of the union message to Congress a few days before the budget was transmitted.

Biggest items for which fiscal '51 funds are requested by Reclamation: Missouri River Basin, $102,057,300; Columbia Basin, $53.5 million; Central Valley, $49 million; Hungry Horse, $30.5 million; Colorado-Big Thompson, $21.7 million; and Davis Dam, $14,320,000.

Delta Plants Again

Despite the ban on new projects, $2 million of the Central Valley appropriation would be used to initiate construction of the controversial Delta steam plants, funds for which were denied by the last session of Congress. Also included in the Central Valley request are funds for preconstruction activities on the authorized American River development.

The increased flood control funds for the Army Engineers are expected to accelerate construction of several major dams which will have large power installations. Substantially larger funds are being sought for most of them.

FUNDS FOR FEDERAL POWER AGENCIES

Agency	Appropriated Fiscal 1950 (000 omitted)	Asked Fiscal 1951
Bureau of Reclamation	$372,900	$355,000
Army Engineers		
Flood Control	336,406	478,447
Rivers and Harbors	197,490	240,714
Southwestern Power Admin.	9,000	11,135
Southeastern Power Admin.	70	175
Bonneville Power Admin.	30,498	47,250
Tennessee Valley Authority	64,264	108,264
Rural Electrification Admin.		
Loans (Electric)	500,000	400,000
Loans (Phone)	25,000	50,000
Administrative	6,963	7,425
Federal Power Commission	4,059	4,494
Securities and Exchange	5,750	6,425
Atomic Energy Commission	703,229	726,112

They include: Ft. Randall, S. D., $37.5 million; Garrison, N. D., $35 million; Buggs Island, Va.-N. C., $30 million; Wolf Creek, Ky., $22.1 million; Clark Hill, Ga., $22 million; Detroit, Ore., $20 million; Bull Shoals, Ark., $18 million; Pine Flat, Calif., $13.5 million; Folsom, Calif., $6.5 million; and Oahe, S. D., $6 million.

Power funds listed for TVA for fiscal '51 include $39,915,000 for New Johnsonville, Tenn., steam plant; $15.4 million for the Widows Creek, Ala., plant; $13,993,000 for continued work on six hydrogenerating units now under construction in existing dams; $6,982,000 for beginning construction on two dam and reservoir projects on the South Fork of the Holston River near Kingsport, Tenn.; $3,419,000 for completion of South Holston Dam, which will begin generating power in the spring of 1951; and $28,919,000 for transmission and other electric facilities.

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Allatoona Dam Filling

Georgia Power Co should receive the first power from Allatoona Dam, near Cartersville, within the next few weeks. The Corps of Engineers closed the four sluice gates late in December, and the dam is filling rapidly. The first unit will have a capacity of 36,000 kw. Later in spring a second 36,000-kw will be ready to go on the line.

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Duke Workers Get Raise

Duke Power Co has completed negotiation of a contract with the International Brotherhood of Electrical Workers, AFL, granting wage increases averaging 8½%.

3 Young Electricals Will Get Eta Kappa Nu Honors

Three young electrical engineers will be honored by Eta Kappa Nu, Jan 30, at New York. The presentation of the Association's annual awards will be made at a dinner held in conjunction with the Winter General Meeting of the American Institute of Electrical Engineers.

Robert C. Cheek, Westinghouse Electric Corp, will receive the award as the outstanding young electrical engineer of 1949. He will receive a miniature replica of the bronze bowl which carries the names of all previous winners and is on display at the AIEE head-

ROBERT C. CHEEK

quarters in New York. Honorable mention certificates will go to Dr Lester M. Field, associate professor of electrical engineering, Stanford University, and to Louis G. Gitzendanner, General Electric Co.

Cheek has been employed by Westinghouse since 1941, when he was graduated from Georgia Tech. He completed the student course and was assigned to the central station engineering section. Since 1945 Cheek has been the headquarters central station engineer assigned to the Southeastern District. An example of his analytical ability is his work on the comparison of modulation systems for power line carrier transmission. The analysis made by Cheek pointed to a solution of the problem that is now used as a standard reference work in the carrier field.

He has written many articles for technical journals, including ELECTRICAL WORLD, and has presented nine papers to AIEE and other technical societies. He has also lectured widely before technical societies and engineering groups.

Cheek's energy and ingenuity have resulted in 23 recognized inventions.

Where TVA Got Its Power in Fiscal 1949

Its hydro plants produced	13,285,649,000 kwhr
Its steam plants produced	2,449,115,000 kwhr
Together TVA's plants produced	15,734,764,000 kwhr
TVA purchased from interconnected systems	234,750,000 kwhr
TVA received in interchange	1,166,827,000 kwhr
The total input of the TVA system was	17,136,341,000 kwhr

Where TVA Distributed Its Power in Fiscal 1949

Federal agencies, industrial plants, utilities took	7,214,194,000 kwhr
144 municipal and cooperative systems took	6,400,000,000 kwhr
Aluminum Co of America under interchange took	1,730,167,000 kwhr
Interchange with other systems took	950,818,000 kwhr
TVA use and system losses amounted to	841,162,000 kwhr
Total distribution equalled input of	17,136,341,000 kwhr

TVA Reports Fiscal '49 Was Year of Greater Revenue and Operations

THE TENNESSEE Valley Authority generated 15,734,764,000 kwhr during the fiscal year 1949, ended last June 30, and chalked up power revenues of $58 million, TVA's annual report disclosed late last month.

Revenues jumped $9 million over the previous year, and net revenues totaled $21.5 million. This was a return of 5% on the average net investment in power facilities, second highest return in TVA's 16-year history. Average annual return for the past five years has been 4.7%, with a high of 5.5% earned in 1947.

During the fiscal year TVA added seven units with a combined capacity of 190,800 kw, compared with a net increase in TVA's installed capacity of only 52,000 kw for the entire three years previous.

Biggest addition during fiscal '49 was 36,000 kw at the Army Engineers' Dale Hollow Dam on the Cumberland River. This power was sold by the Department of Interior. TVA will get an additional 405,000 kw by the end of 1952 from two other Cumberland Dams now under construction, Center Hill and Wolf Creek.

In all, TVA's 1949 report looks to the addition of 1.2 million kw during the next three years. It will come from the Cumberland Dams, the 375,000-kw New Johnsonville steam plant, and the addition of 390,000 kw in new hydro capacity at TVA dams.

Installed capacity of the system on June 30 was 2,747,092 kw. By the end of 1952, it is expected to reach 3,959,160 kw.

Not included in these figures is the 250,000-kw Widow's Creek steam plant which Congress will be asked to approve early in the new session.

Peak hourly demand for the TVA area during fiscal 1949 was 2,419,900 kw, a jump of 285,000 kw over 1948. Including deliveries to utilities outside the TVA service area, the figure was 2,666,000 kw, an increase from 2,457,500 kw in the previous year.

During the year municipal and co-op power distributors served by TVA added 120,000 new consumers, three fourths of them in rural areas. By June 30, total customers were 985,000 and soon after the number passed 1 million.

TVA reported residential use averaging 2,762 kwhr, compared with a national average of 1,625. Rates averaged 1.54¢ per kwhr.

Four times as many people in its area have electric service as had it 16 years ago when TVA began, and the federal agency said that the average home in its area is now using five times as much electricity as in 1933.

Cash available from TVA's power operations in the fiscal year was $30.8 million and this plus a cash balance from 1948 of $7.6 million was allotted as follows: $27.7 million reinvested in power facilities, $2.5 million used to retire bonds, $3 million paid into the Federal Treasury under TVA Act, and $5.2 million balance on hand June 30, 1949.

Santee-Cooper and Co-op Sign Contract for Lines

South Carolina Public Service Authority (Santee-Cooper) and the General Electric Power Cooperative, Inc, have signed a "contract obligation" for construction and operation of a 700-mile electric transmission system in 27 South Carolina counties.

South Carolina Electric & Gas Co, Columbia; South Carolina Power Co Charleston; and Carolina Power & Light Co, Raleigh, N. C., lost a court fight against the contract last year.

The co-op will build the lines with a $7,595,000 loan recently approved by Rural Electrification Administration. When the system is finished Santee-Cooper will take it over, operate it, and pay for it.

The Authority will make semi-annual payments in amounts sufficient to liquidate the debt at 2½% interest in 35 years. The distribution co-ops will be charged six mills a kwhr, compared to 7½ mills now charged them by privately owned utilities, Santee-Cooper officials said.

Seventy-eight percent of the initial capacity will be used to supply the needs of rural electric cooperatives. The remaining capacity will be used to supply customers of any classification "who wish to buy" Santee-Cooper power. Work on the two-year program is expected to begin in 90 days.

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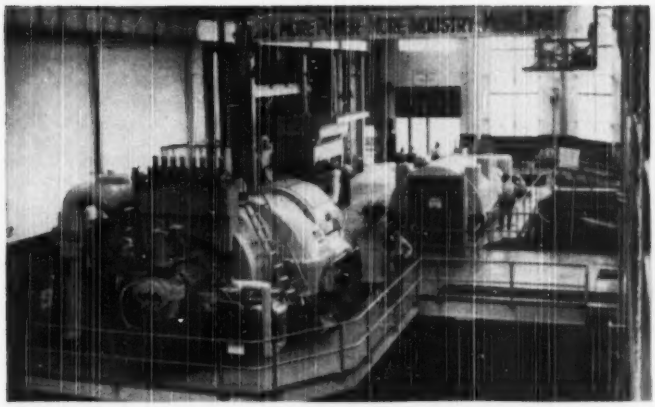
October Output Below '48 But 1.5% over September

Energy production declined in October as compared to the corresponding month a year ago for the first time since July, 1946, the Federal Power Commission reports.

Production of energy by electric utilities in October totaled 24,288,194,000 kwhr, a decrease of 0.4% from October, 1948, but a rise of 1.5% above the 23,921,565,000 kwhr produced during September, 1949.

Hydro production rose 16.1% over October, 1948, to 6,935,536,000 kwhr. As a percent of October's total production water power output increased from 24.5% last year to 28.6% this year. October production by fuel plants was 17,352,658,000 kwhr.

Electric utility production for the year ended Oct 31 reached 290,279,649,000 kwhr, 4.4% more than during the year ended Oct 31, 1948. Production for the year ended Oct 31, 1949, was slightly below the record 12-month output during the period ended a month earlier.



CLEAN as a parlor is the Pueblo Plant of Southern Colorado Power Co during "open house" following dedication of 15,000-kw unit which increased plant capacity to 36,000 kw

Truman Calls for More Public Power Projects

Amid speculation that election-year considerations will shorten the new session of Congress and doom much long-range legislation, President Truman repeated his requests for the St. Lawrence Seaway and Power Project and a Columbia Valley Administration.

In his State-of-the-Union message, the Chief Executive added a new federal power request, urging that "the benefits of large-scale public power development" be brought to New England.

Asked about his power program at a press conference, the President hauled out the growing list of big regional developments urged by public power proponents. Passamaquoddy would be a part of the proposed New England development. In addition to CVA, there were California's Central Valley, power expansion in the Southwest and Southeast and further growth for TVA. The Missouri River Pick-Sloan plan, he suggested, might evolve into a river authority.

But the President also said that he saw no objection to transmission of federal power by private companies when they could do it as cheaply as the government.

Meanwhile, Congressional observers saw little chance for major action on the power proposals in the Presidential messages.

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U. S. Appeals Idaho Case

The U. S. government has given notice of appeal to the U. S. Circuit Court of Appeals from Federal Judge C. C. Cavanah's decision ruling that the Idaho Power Co did not trespass on public lands. The Government also appealed from the federal judge's refusal to erase the case from the records.

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City Taxes Chehalis PUD

Chehalis, Wash., has passed a tax of 3% on gross incomes of any firm selling or furnishing electric power. Since the only firm in this category is the Chehalis Public Utility District No. 1, the tax is one on the revenues of this PUD only. The tax was needed to replace one on pinball machines, which have been ruled illegal by the State Supreme Court.

Reclamation Projects Set Output Marks in '49

Bureau of Reclamation projects produced a record-breaking 19 billion kwhr of hydroelectric power during 1949 by driving big generators to produce above rated capacity and running every plant at near capacity most of the time.

The 1949 figure, 1.5 billion kwhr above 1948, was made possible "by careful supervision and management of equipment for the first sign of possible damage," Commissioner Michael Straus declared. He said that combined peak production rates as high as 3,060,430 kw were achieved with generators rated at a top total of 2,998,400 kw at Grand Coulee. 108,000-kw generators were frequently stepped up to 130,000 kw.

Grand Coulee additions represented 324,000 kw of a total of 424,000 kw capacity added during the past year, Reclamation's year-end summary showed. Remaining new installed capacity was in California's Central Valley, 75,000 kw at Shasta, and 25,000 kw at Keswick.

For the new year, Coulee will add another 334,000 kw of an anticipated capacity gain of 533,100 kw. Other new Reclamation power units slated to come in during 1950 include: Keswick, 50,000 kw; Davis, Lower Colorado River, 45,000 kw; Estes and Marys Lake, Colorado-Big Thompson Project, 53,100; Anderson Ranch Dam, Boise project in Western Idaho, 27,000 kw; and Kortes, North Platte River in central Wyoming, 24,000 kw.

MEMPHIS, TENN., was hit by the severest ice storm in 17 years on Jan. 6. Thousands of customers of the Memphis municipal system were without power as wires and poles toppled

Niagara Mohawk Formed, Elects Machold President

One of the nation's largest integrated electric operating companies was formed last week when consolidation of the Niagara Hudson Power System's three principal subsidiaries into the new Niagara Mohawk Power Corp became effective.

Earle J. Machold, president of the dissolving Niagara Hudson, was elected president of the new company, and his father, H. Edmund Machold, was named vice-president and chairman of the executive committee. Other officers, all of whom have long been associated with the consolidated companies, are vice-presidents, George J. Brett, also controller; Edwin S. Bundy, chief engineer; Lauman Martin, general counsel; Charles A. Tattersall, secretary; William L. Collins; Wesley J. Gilson; John L. Haley; John T. Kimball; Leland D. McCormac; A. T. O'Neill; and Gustav F. Watters, and treasurer, James H. Morrell.

Dissolution of the holding company is expected to become final early in 1951. Niagara Mohawk will then inherit the name Niagara Hudson Power Corp. The system, which consisted of 59 companies when it was organized in 1929, then will be a single operating company with five subsidiaries, Niagara Falls Power Co, Canadian Niagara Power Co, Ltd, Frontier Corp, Oswego Canal Co, and St. Lawrence Power Co, Ltd.

The new company has been formed by consolidation of Buffalo Niagara Electric Corp, Buffalo; Central New York Power Corp, Syracuse; and New York Power & Light Corp, Albany. From the viewpoint of total output it will be the country's largest completely integrated electric operating company. It will serve an upstate New York territory with a population of 2.8 million persons.

One of Niagara Mohawk's first corporate acts will be the offering of $40 million of 30-year mortgage bonds at public bidding this month. Proceeds will be used to pay off short-term notes aggregating $38.5 million and for construction purposes. The company expects to require $24 million of additional financing for construction and plant expansion in 1950.

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Utility Sold to Co-op

Linville Power & Light Co, Altamont, N. C., has been sold to Mountain Electric Cooperative, Mountain City, Tenn. The sale price is believed to have exceeded $60,000.

FINANCIAL BRIEFS

Ontario Hydro Commission has turned down a suggestion that it dip into its $20-million reserve fund to offset rising costs of electric power production. Officials of two Ontario cities made the suggestion after the commission had announced a 25% wholesale rate increase.

New York State Electric & Gas Corp has borrowed $10 million from two life insurance companies on 2.80% first mortgage bonds due 1979. Proceeds will be used to repay temporary bank loans and for construction.

Central Illinois Light Co will redeem on Jan 20 all its first and consolidated mortgage 3½% bonds due 1966. Bondholders will be paid 104⅞ plus accrued interest to the redemption date.

Stockholders of Cincinnati Gas & Electric Co have authorized an increase in the number of common shares to six million. The company now has issued 2,493,334 of an authorized 2.5 million shares and plans to sell 560,000 shares this year to finance expansion. Stockholders also waived prior rights to subscribe 58,000 shares of common to be offered for sale to employees of the company when the next offering is made to shareholders.

A committee for common stockholders of Eastern Utilities Associates has been formed to intervene in the company's reorganization proceedings before the Securities and Exchange Commission. The committee is interested in consideration for the annual dividend preference of $2 a common share.

SEC has reiterated its request of four years ago for extending provisions of the Securities Exchange Act to some unregistered securities. Nineteen public utility holding companies registered with the Commission but having unregistered stock with a market value of $537 million would be included. "The only effect of the proposed legislation upon these companies," according to SEC, "would be to subject 10% stockholders to the insider trading provisions of the Securities Exchange Act and bring into play the prohibitions against short selling by insiders."

Cumberland Public Service Co of Kentucky will not have to pay federal income taxes on the sale of its properties to the Tri-County Electric Membership Corp., Gray, Ga., for $104,000, the Supreme Court decided 8-0, Jan 9. The court, in an opinion by Justice Hugo L. Black, found that the sale had been made by Cumberland stockholders "following a genuine liquidation and dissolution."

GPU Asks OK on Sale of Staten Island Edison

General Public Utilities Corp has asked Securities and Exchange Commission for permission to sell its common stock interest in Staten Island Edison Corp.

Exemption from competitive bidding was requested. Part of the proceeds will be invested in Metropolitan Edison Co, Reading, Pa., and New Jersey Power & Light Co, Dover, subsidiaries. Metropolitan will get a $4 million cash contribution and New Jersey $650,000.

To raise additional construction funds Metropolitan plans to sell $7 million of first mortgage bonds due in 1980 and 30,000 shares of $100-par cumulative preferred at competitive bidding. New Jersey will sell at competitive bidding 20,000 shares of $20-par cumulative preferred.

GPU is now in the last stages of becoming an integrated holding company. It controls only five major subsidiaries in Pennsylvania and New Jersey and one in the Philippine Islands, in contrast to the 300 companies that once made up its predecessor, the late Howard C. Hopson's Associated Gas & Electric System. New York State Electric & Gas Corp and Rochester Gas & Electric Corp were sold to GPU stockholders last year.

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Tax Compromise Reached in Reorganization Case

Judge James Alger Fee, in federal court at Portland, Ore., has approved a compromise payment of $904,234 for federal tax deficiencies from the reorganized Portland Electric Power Co. The compromise authorized payments of $607,364 by Portland General Electric Co and $296,870 by Portland Traction Co, subsidiaries of the old Portland Electric Power Co.

The payments satisfy tax claims filed by the federal government of more than $5.6 million for the years 1942 through 1947. Only remaining step in the holding company reorganization proceedings, which began 10 years ago, is settlement of a claim of some $60,000 by the State of Oregon for taxes due in 1948.

Output Turns Upward, Still Running Under 1949

Output turned upward again in the week ended Jan 7 after the usual Christmas slump.

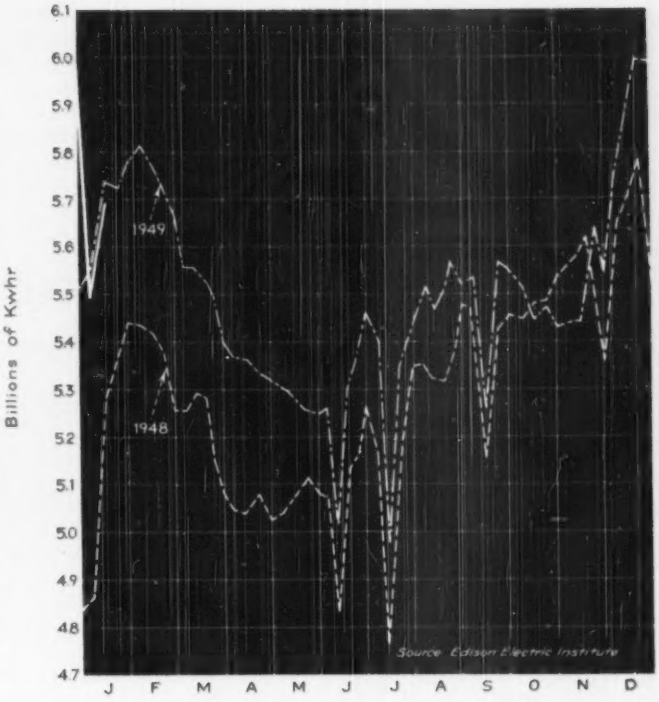
The 5,695,372,000 kwhr distributed that week by the nation's electric light and power companies was 0.8% below the 5,741,663,000 distributed in the corresponding week a year ago, largely because the week ended Jan 8, 1949, included less of the New Year holiday. However, output for the Jan 7 week was well above the week before.

Weekly Output, Millions Kwhr

1950		1949		1948	
Jan 7	5,695	Jan 8	5,742	Jan 10	5,278
1949		1949		1948	
Dec 31	5,493	Jan 1	5,562	Jan 3	4,868
1949		1948		1947	
Dec 24	5,994	Dec 25	5,508	Dec 27	4,826
Dec 17	5,997	Dec 18	5,790	Dec 20	5,368
Dec 10	5,881	Dec 11	5,705	Dec 13	5,327
Dec 3	5,743	Dec 4	5,646	Dec 6	5,218
Nov 26	5,537	Nov 27	5,349	Nov 29	4,983
Nov 19	5,644	Nov 20	5,627	Nov 22	5,180
Nov 12	5,435	Nov 13	5,571	Nov 15	5,084
Nov 5	5,435	Nov 6	5,564	Nov 8	5,057

Percent Change from Previous Year

	Jan. 7	Dec 31	Dec 24
New England	+ 0.4	— 0.7	+10.9
Mid-Atlantic	— 6.0	— 4.9	+ 3.6
Central Industrial	— 3.7	— 2.1	+ 8.8
West Central	+ 2.9	+ 5.7	+11.9
Southeast	+ 1.6	0.0	+10.7
South Central	+ 4.7	+ 3.0	+18.0
Rocky Mountain	+ 0.6	— 5.8	+ 4.9
Pacific Coast	+ 4.6	— 0.8	+ 9.9
Total United States	— 0.8	— 1.3	+ 8.8



MEETINGS

Canadian Electrical Association
Annual Winter Conference, Chateau Frontenac, Quebec, January 16-18.

Plant Maintenance Show and Conference
Auditorium, Cleveland, Ohio, January 16-19.

Southeastern Electric Exchange
Industrial Relations Conference, sponsored by Edison Electric Institute Industrial Relations Committee, SEE Personnel Administration Section, and Southwest Personnel Committee, Roosevelt Hotel, New Orleans, La., January 19-20; Engineering and Operating Section, Buena Vista Hotel, Biloxi, Miss., March 23-24, Annual Conference, Greenbrier Hotel, White Sulphur Springs, W. Va., April 12-14.

Southwest Air Conditioning Exposition
Hall of Agriculture and the Poultry Building, Fair Park, Dallas, Tex., January 23-27.

American Society of Heating and Ventilating Engineers
Annual Meeting, Adolphus and Baker Hotels, Dallas, Tex., January 23-27.

American Institute of Electrical Engineers
Winter General Meeting, Hotel Statler, New York, N. Y., January 30-February 3; Power Conference sponsored by Committees on Power Generation, Industrial Power Systems, and System Planning, William Penn Hotel, Pittsburgh, Pa., I. Power Generation, April 19, II. Industrial Power Systems, April 20.

Missouri Valley Electric Association
Power Sales Conference, President Hotel, Kansas City, Mo., February 9-10; Engineering Conference, President Hotel, Kansas City, Mo., March 29-31.

Edison Electric Institute
Electrical Equipment Committee, Netherlands-Plaza Hotel, Cincinnati, Ohio, February 13-14; Industrial Relations Committee, Palmer House, Chicago, Ill., February 16; Transmission and Distribution Committee, Statler Hotel, Detroit, Mich., February 20-21; Industrial Relations Committee, EEI, headquarters, New York, N. Y., March 16; Netherlands-Plaza Hotel, Cincinnati, Ohio, April 20; Annual Sales Conference, Edgewater Beach Hotel, Chicago, Ill., April 4-6; Purchasing and Stores Committee, Schroeder Hotel, Milwaukee, Wis., April 24-26.

Pennsylvania Electric Association
Transmission and Distribution Committee, Penn-Harris Hotel, Harrisburg, Pa., February 16-17; Joint Midwinter Meeting, Electrical Equipment Committee and Prime Movers Committee, Robert Treat Hotel, Newark, N. J., February 23-24.

National Adequate Wiring Bureau
Adequate Wiring Conference, Statler Hotel, St. Louis, Mo., February 16 and 17.

American Society for Testing Materials
Committee Week and Spring Meeting, Hotel William Penn, Pittsburgh, Pa., February 27-March 3.

National Rural Electrification Association
Annual Convention, Hotel Stevens, Chicago, Ill., March 6-9.

National Electrical Manufacturers Association
Edgewater Beach Hotel, Chicago, Ill., March 13-16.

Conference for Protective Relay Engineers
Department of Electrical Engineering, Agricultural and Mechanical College of Texas, College Station, Tex., March 20-22.

American Public Power Association
Annual Convention, Shoreham Hotel, Washington, D. C., March 28-30.

* **National Association of Purchasing Agents**
Annual Midwinter Conference, Hotel Statler, Detroit, Mich., February 13-14.

* **Midwest Power Conference**
Sherman Hotel, Chicago, Ill., April 5-7.

* **American Society of Mechanical Engineers**
Spring Meeting, Hotel Statler, Washington, D. C., April 12-14.

* **Indiana Electric Association**
Annual Young Men's Utility Conference, Ipalco Hall (employees' recreation center of Indianapolis Power & Light Co.), Indianapolis, Ind., April 18-19.

Electrochemical Society
Annual Meeting, Hotel Statler, Cleveland, Ohio, April 19-22.

* Additions This Week.

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Co-op Buys Inland Plant

Jemez Mountain Electric Cooperative has presented a $1-million check to Inland Utility Co, Espanola, N.M., in payment for the Espanola electric plant, which the co-op now operates and will later expand. The co-op plans to bring electricity to more than 1,100 farms in the Jemez Mountain area of New Mexico and to add 5,000 customers to the 3,500 now served.

•

Con Ed Rate Cut Upheld

The New York Public Service Commission's right to fix temporary rates for Consolidated Edison Co of New York, Inc, has been confirmed by the New York Court of Appeals. The 5-2 decision reversed an order of the Appellate Division. In December, 1948, the Commission had ordered the utility to reduce its electric rates by 10%.

WASHINGTON COMMENT

WILLIAM B. WHICHARD

ELECTRIC UTILITIES, like many other groups, would benefit from an equitable resolution of conflicts in federal policies governing development of water resources. A uniform standard for establishing federal hydro power rates, for example, would end uncertainty in both private and public utility quarters. At the present, however, there seldom is any sensible relation between rates charged for federal power produced in different sections of the country or by different federal power agencies.

This is one of the problems, albeit a minor one, to be dealt with by the President's new, temporary Water Resources Policy Commission. In broader terms, the Commission's principal assignment apparently is to recommend uniform policies for all federal water development programs. According to present plans, this will require answers to three or four basic policy questions: How much and what kind of water development should the government undertake? Which programs should be undertaken first? What kind of yardstick should be used to determine the feasibility of federal projects? What new resource development legislation is needed to clarify and expedite federal work in this field?

In answering these questions, the Commission is expected to come up with many more specific recommendations, including some on power rates. In the same category will be its findings on cost allocations for multi-purpose projects, existing preferences for certain classes of power customers, the period for repayment of power and other reimbursable costs, the utility responsibility—if any—assumed by the federal government in connection with such projects.

Of only slightly less interest to the industry will be the Commission's anticipated recommendations on calculation of benefits, the 160-acre limitation for irrigated farms, and policy squabbles between the Interior and Agriculture Departments.

The whole tangle of water policy confusion has developed over a long period of years, as agency after agency became interested in development. But the more or less recent debut of the multiple purpose dam brought the matter to a critical head. The Hoover Commission, in addition to recommending reorganization of the federal machinery for building and operating such projects, pointed to the need for uniform water policies. President Truman, urged by former Interior Secretary Krug, among others, has been interested in the problem for several months. Early last November, an Administration spokesman revealed that a policy study was imminent.

Though everyone is agreed that the present policy tangle needs straightening, the utility industry—for one—can find little to cheer about in the composition of the new Commission. It is difficult to imagine that any body headed by Morris Cooke will recommend a revision of the preference policy to give power companies more equitable consideration. Nor is Leland Olds, who may become the most potent member of the Commission, expected to come up with a cost allocation standard any more realistic than the one he sponsored for the Bonneville project in 1945.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Silicones repel moisture so well that rubber latex can easily be flushed from glass laboratory equipment to which it otherwise adheres tenaciously.

Relaying will some day use such devices as magnetic amplifiers and transistors but not until the reluctance on the part of some engineers to electronic methods is intelligently overcome.

Planting food for game and wild life on transmission rights of way is better than letting rank growth get started.

Suspension clamps, with saddles long enough to extend beyond the point of inflexion and thus avert the consequences of localized flexure, are being used throughout a Scandinavian 120-kv line.

ACSR is being tried out experimentally in a 2,800 ft line of No. 4 (6/1) with aluminum coating on the steel strands instead of zinc. Expectation is that it could prove superior and ultimately justify commercial production.

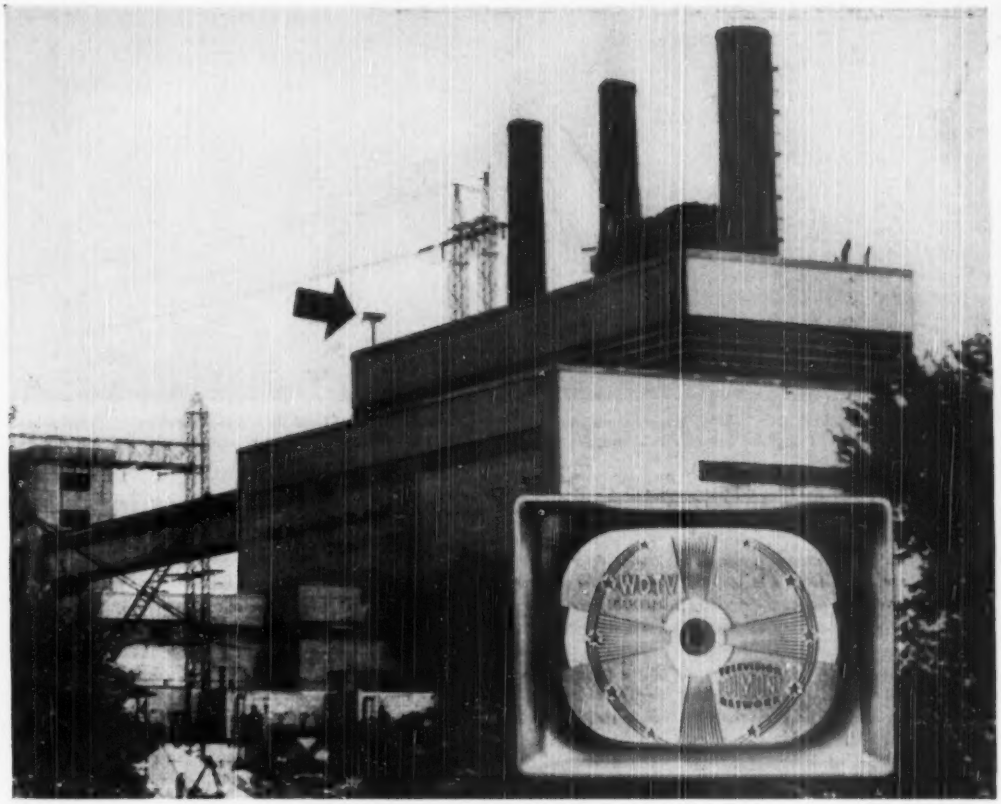
"Professionals equipped with the right tools can make economic monkeys of amateurs" (William Feather).

Dust and cinder collectors in utility plant constitute 80% of the total in use. Yet the electric utilities burn less than 20% of the coal consumed annually. Industry generally is doing only a fraction as much about air pollution as the power companies.

Coil bolts should not be allowed to come in contact with the end of generator coils, otherwise corona and breakdown may occur.

Lignite does not need to be dried below 17-28% in order to pulverize readily and burn well.

Water-repellent surface materials on line wires might be an effective answer to glaze formation and storm breaks—if the effect can be made permanent.



TELEVISION SET IN TIDD PLANT gives excellent reception. Folded dipole and director on roof is near high voltage lines. Lead is 170 ft of 300-ohm twin lead. Vicinity's poor reception is due to low elevation and distance from transmitter, not power interference

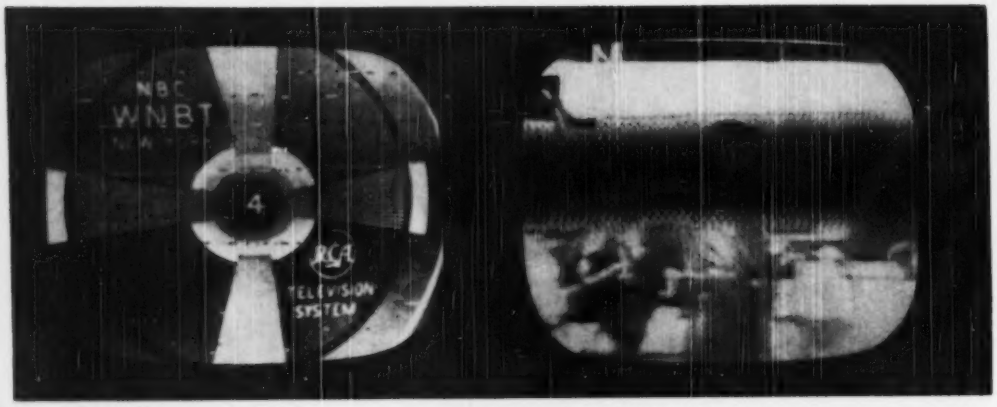
Television Interference Seldom Comes from Power Systems

F. L. GREENE
Inductive Coordination Engineer
The Ohio Power Co, Canton

Most severe offenders in order of severity are automotive ignition, diathermy, old tungsten lamps, germicidal lamps, door openers, dielectric heating and customer appliances

BECAUSE TELEVISION is a comparative infant, and a considerable amount has to be learned before all causes of video interference and its preventatives or remedies can be determined, it is not surprising that the public frequently enters its complaints regarding interference with power companies as they did in the pioneering days of sound-radio in the early 1920's.

In some cases, video dealers and servicemen have told television users that interference is due to power lines, and that the power company should remove the cause. The majority may be sincere in their belief that the trouble is not inherent in the television sets or other customer-owned equipment, but various causes exist as shown by the accompanying list based on our tests to date. Cooperation with everyone concerned—sources of interference, customers, video manufacturers, distributors, dealers and servicemen—will be required to widely disseminate information regarding the causes, their



1 **AUTOMOTIVE IGNITION SYSTEM** causes characteristic interference in form of broken horizontal lines of irregular pattern

2 **MILD DIATHERMY** interference shows up as a central band across picture in characteristic "marble frosting" pattern

Utilization devices in homes as well as industry

relative magnitude, the range of disturbance, and manifestations on the screen. Preventatives and remedies, particularly, will require cooperation of all.

Portable test sets for locating and diagnosing troubles have revealed the facts listed herein, and more may be unearthed with further investigation. New types of interference are showing up continually.

Investigation Equipment

In an attempt to find adequate instruments for investigating television interference complaints and locating causes, we purchased one 7 in. portable Motorola television receiver (Model VT 73). Initially we added a signal strength meter, a switch to disable the automatic gain control system of the set, and a manual contrast-control. These refinements were soon found unnecessary and even a handicap in some cases, where it was necessary to demonstrate to complainants or their servicemen that the trouble was in their sets and not due to interference. Suspicions were aroused by our modified sets. A standard set without modifications is more suitable for such purposes.

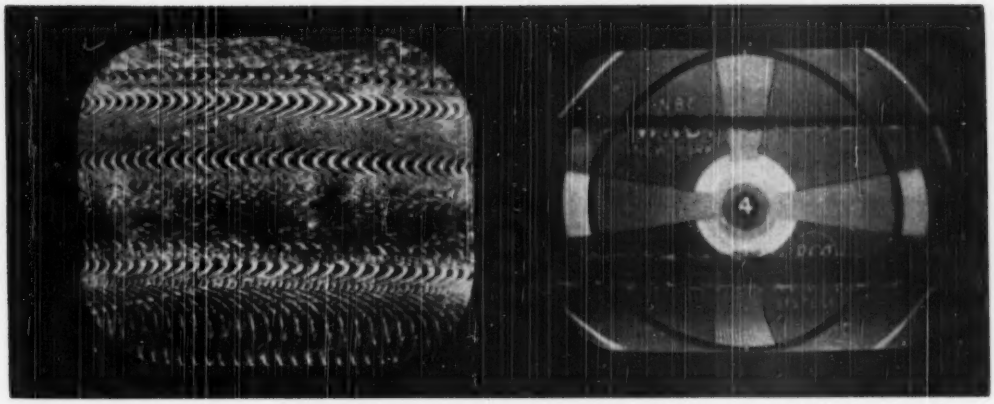
Initial tests with this modified portable Motorola television set were made to get first-hand information on the influence of our transmission-distribution system (4-22 kv) on television receivers in close proximity to the lines and substations. For these tests and any others away from permanent television antennas, we use an adjustable portable antenna which is demountable and may be stored in the trunk compartment of any standard coupe. The antenna, composed of a dipole and reflector, is mounted on a portable mast made of four 5-ft sections of standard 1¼ in. hot sticks. When it is extended the full 20-ft length, we use clothesline and regular marker stakes for guys.

If preliminary investigation of a customer's television interference complaint and a call to his serviceman convinces us that the trouble is due to the customer's receiver, we urge trying another set alongside his existing set. When this suggestion is not applied, we connect our portable Motorola set to the customer's antenna to prove where the trouble actually exists.

Listening—TV Off The Air

However, this portable test set is not the complete answer for locating causes of television interference. Many types of television interference are more easily diagnosed while the television broadcasting station is not "on the air", by the "listening test" with continuous tuning, which has been used by our interference engineers for many years to locate sources of interference with standard broadcasting. Several reasons exist. Several types of interference produce approximately the same pattern on the video screen, yet have slightly different sounds on the listening test. When a television receiver is tuned off to the side of the broadcasting channel, any interference sounds practically the same as on a standard AM receiver. Furthermore, while listening to interference while video broadcasts are in progress, the video signal produces a sound which tends to mislead the investigator in certain cases. Television broadcasting also handicaps getting a directional bearing on any specific interfering RF signal, because the video signal combined with the RF interference and the changing signal ratios prevent obtaining a true direction.

A new test combination will be tried out as time and availability of necessary parts permit. A Du Mont input-tuner (Mallory "Inductuner" continuous tuning) will be modified to use low-drain battery-type tubes and employed as a converter ahead of our standard Halicrafter Type S39 and S72 radio interference receivers, also ahead of our mobile all-wave car radio units. Since the latter cover a range of 540 kc to 30 mc, these sets could be used at approximately 26 mc in a double-conversion superheterodyne combination. The Du Mont input-tuner might be revised to plug into the side of the Halicrafter receiver, when necessary, and receive its power from the Halicrafter internal batteries. So far however, there are no low drain battery-type



3 **SEVERE DIATHERMY** interference spreads all over the picture area, also in the typical marble frosting pattern

4 **TUNGSTEN LAMPS** of the old zig-zag filament design may emit oscillations which result in two horizontal bands

are much worse offenders than power lines

substitutes for the 6J6 mixer and RF input tubes of the Du Mont input-tuner. Consequently redesign of the circuits may be necessary to serve our objective. At present we are using a Mallory Inductuner ahead of a Halicrafter S-27 receiver in the author's car a combination which has proved quite effective.

Causes of television interference, so far encountered and detailed in ensuing paragraphs, in their order of nuisance value and severity are:

I Ignition systems
II Old diathermy equipment
III Old-type tungsten-filament lamps
IV Some germicidal lamps
V Various radio-transmitting equipment
VI Some electronic garage-door openers
VII Dielectric-heating equipment
VIII Some customer-owned household appliances
IX Power-line noises

Plain lack of video signal strength and defective antennas or installations cause other complaints whose nature obviously indicates that they cannot be classified as interference.

In practically every case of television or radio interference, one of the best clues to the source can be obtained from a record or log of the exact day and time the interference started, and the duration of each interference period, however large or small. The date of the first interference is very valuable. On our first trouble call, if the radio-interference engineer believes such a log will save time in locating the trouble, the customer is requested to make such a record. A call back is then made at a later date and the trouble investigation continued.

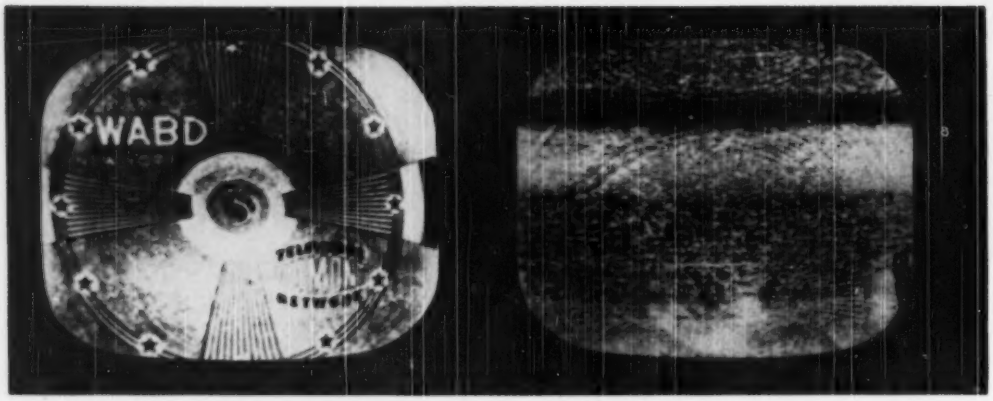
I Ignition Systems On Automobiles Old models of some makes of cars are bad offenders. The effect on the television screen is to produce broken horizontal lines across the picture.

Ordinary distributor-type suppressors materially reduce this interference. Resistor-type spark plugs (like Auto-Lite) practically eliminate the interference and simultaneously improve gasoline-engine performance, especially in smoother idling on high-compression motors. Chrysler Corp is installing such plugs as standard equipment on all this year's models. All car manufacturers should eventually install preventative equipment at the factory.

In some cases of interference due to ignition, we recommend relocation of the antenna to shield it from passing cars.

II Diathermy Equipment Old-type, self-excited, self-rectified diathermy equipment operating at random in the radio-frequency spectrum is a serious cause of interference because of its fairly high-power radiation, and/or strong harmonics. Severe interference from this source may produce a heavy-black band across the picture, which changes to a light irregular S-shaped vertical pattern when the interference has less intensity. Fortunately, the Federal Communications Commission ruled against this old-type diathermy equipment about 3½ yr ago and gave doctors 5 yr in which to amortize their investment in such equipment purchased prior to that time and substitute approved equipment. All new diathermy equipment produced since the FCC ruling has been crystal-controlled, has filtered d-c power supply, and is assigned to specific operating channels.

Interference has been effectively reduced by two methods: (1) Shielding the diathermy equipment and the treating areas; (2) where certain treatments produce interference, those specific frequencies are altered by spreading or compressing the turns in the tank circuit. Shielding a portion of the treating leads is effective in lowering the output frequency when it is impossible to spread or compress the tank-circuit turns. This provides additional capacity across the self-excited tank circuit. The second remedy (altering frequency) was necessary in several cases before the advent of television, to avoid interference with our 31.46 mc space-radio channel. In one case where severe



5 **HOUSEHOLD APPLIANCES** may produce "sand paper" or "snow" patterns which when mild (above) dot the picture received

6 **HOUSEHOLD APPLIANCE** interference when severe causes obliterating "snow" pattern. Commutators are worse offenders

Characteristic television picture patterns are

diathermy interference of television was traced to a hospital, the seriousness of the situation was explained to the hospital officials who readily agreed to purchase three new FCC approved units immediately to alleviate the situation.

Two of the new FCC approved units with crystal control were found to produce a sufficiently strong third harmonic to cause interference with Channel 5, one block away. Rather stringent regulations should be formulated and enforced to limit radiation of harmonics, especially the third. It could be accomplished by specifying the maximum permissible spurious output, which should be considered in the design and manufacture of diathermy equipment.

III Old-Type Tungsten-Filament Lamps The old-type lamp using straight tungsten wire, folded several times over supports at the base and top is not only an inefficient light source but a cause of television interference. Such lamps have extremely long life and many are still used in some hallways, bathrooms and other places where the amount of light is not of prime importance. Such lamps emit an RF signal usually around 20 to 27 mc, modulated several hundred percent at power-line frequency. This radiation is rich in harmonics which fall into one or more of the low-band television channels.

The effect on the picture is approximately the same as that of diathermy, except for duration. Some of these offending lamps may be left on hours at a time, which would indicate that short-use diathermy is not involved. The maximum area affected by old-type tungsten lamps is approximately 3 blocks in radius from the offending source. Sometimes the interference appears as two or more narrow bands. Tests with several of these old lamps show the signal is very broad—about 2 mc at the fundamental frequency of approximately 25 mc.

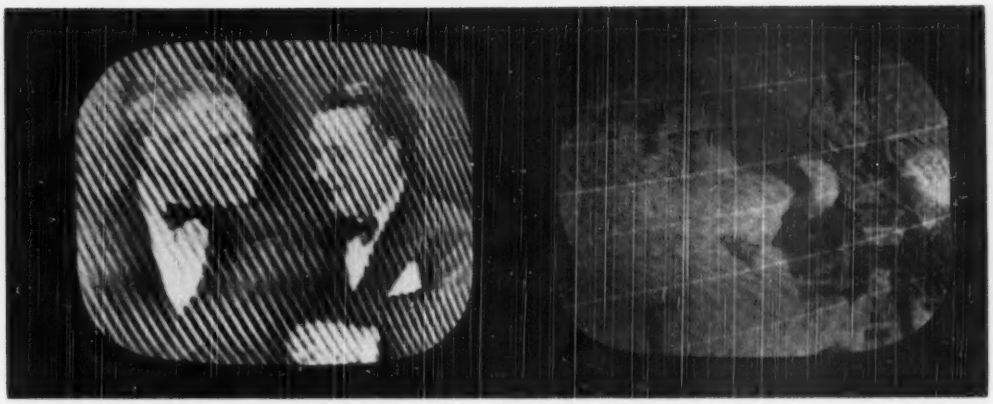
The cause of interference appears to be due to their acting as dynatron oscillators at the points inside the bulb where the tungsten filament from the base terminals approach the tip of the bulb. At these points a slight carbon deposit develops on the wire and naturally a difference of potential exists between these two points. This might not occur if the lamps were completely evacuated. In fact, it appears that only those lamps with a small remaining amount of air or gas impurities oscillate to cause television interference.

Location of such interference is, in most cases, very difficult at present due to the irregular operating time of the offending lamps. If the customer's antenna can be easily rotated, it may be turned to determine the direction of the offending source, and thus help locate such lamps. Location of such interference would be greatly aided by using a battery-operated portable television set such as mentioned in the accompanying article.

IV Germicidal Lamps Some types of germicidal lamps used with walk-in coolers, freezer lockers, and in butcher shops cause extreme television interference because they radiate a signal due to being energized at an RF voltage supplied by vacuum tubes housed in bakelite compartments on either end of the lamp. They radiate a fundamental frequency between 20 and 37 mc and also a second harmonic which is very severe in television channels. Interference is caused over a radius of approximately 8 blocks.

This interfering type of lamp is no longer made; the manufacturers now produce only the so-called cold-cathode type which operates directly from a 60-cycle power supply. So far the new type has not been found to produce interference. Manufacturers have a trade-in arrangement whereby users can get a new cold-cathode germicidal lamp at a price based on the number of months the old type lamps, which has been causing the interference, has been used.

V Transmitting Equipment Sometimes transmitting equipment such as AM or FM broadcast stations, police, taxicab, amateur, state-highway and utility space-radio systems



7 **NEIGHBORING RECEIVER** may emit radiation causing diagonal slashes to appear on the screen if the signal is moderate

8 **NEIGHBORING RECEIVER** emitting strong radiation may result in inversion similar to that of a photographic negative

clues to the identity of the interference sources

emit strong enough harmonics to interfere with television reception. In very close proximity to such transmitters, the front end or RF stage of the television receiver may be blocked by the fundamental frequency of the transmitting station. Another prevalent type of interference by transmitting equipment operating at its assigned frequency is caused by direct pick-up of the carrier by either video or sound IF systems in the television receivers.

The first type of interference may be readily prevented in the offending transmitter by trapping out the unwanted harmonics which serve no useful purpose anyway. The cure can be fairly easily effected by additional resonant circuits or by attaching to the transmission line quarter-wave open stubs or half-wave shorted stubs cut for the interfering harmonic. The owner should have no objection, particularly since his license may be revoked for emitting spurious frequencies.

Overloading of the front end of the television receiver may be cured by adding tuned traps or a stub line tuned to the fundamental frequency of the interfering transmitter, or a high pass filter in the receiver antenna lead.

Direct pick-up by the IF systems may be remedied by traps in the receiver circuits, and shielding or changing the IF frequency of the receiver.

VI Electronic Door Openers Some modern garage-door openers radiate fairly strong RF signals which sometimes interfere with television reception. At least one make of garage-door opener, employing a small transmitter in the automobile and a receiver in the garage, utilizes radio signals that can actuate the mechanism when the proper automobile is two or three blocks from its garage. Since the receiver in the garage must be in readiness all the time that the car is out, the local oscillator emits a signal which may produce television interference within a radius of approximately two blocks.

This may be one clue to location of such interference which shows up on the television screen as vertical or leaning corduroy lines, usually rather unstable. The frequencies involved usually fall in the high channels (11, 12 or 13) because the frequencies of several door openers of this type in the same area must be staggered so each car owner can open only his own garage doors. So far, a report to the sales agency for the door-opener in this area has brought about corrective measures, frequently by shifting the door-opener RF away from the television channel.

VII Dielectric Heating Equipment Dielectric heating equipment such as used in curing rubber and processing plastic, is usually high-powered (5 to 50-kw output). Consequently the RF radiation may interfere seriously with television sets at considerable distance. One installation used in sewing plastic materials and rated at 15 kw made reception on channel 3 impossible within a radius of several miles.

At close range, the effect on the screen was similar to that of diathermy equipment with picture reversal; at greater distance, it appeared more like a corduroy pattern.

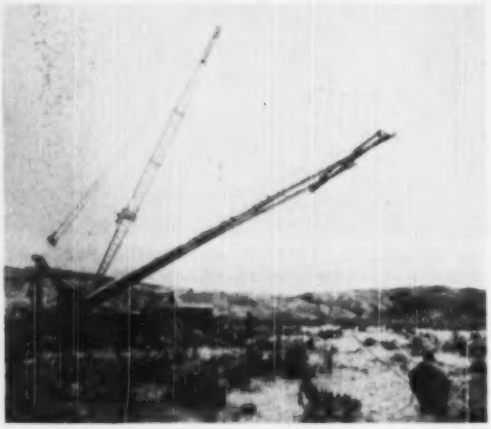
Very careful layout of the initial dielectric heating installation plus its adequate shielding and/or change of frequency seem to be the only ways to minimize such radiation. The last two remedies corrected the specific case of interference mentioned above.

VIII Customer-owned Appliances Customer-owned appliances such as vacuum cleaners, electric sewing machines, electric shavers, etc, sometimes produce television interference similar to that caused by ignition, except for a more consistent screen pattern showing a horizontal streak. Fortunately this type of interference takes place in a local area, usually within 100 ft of the source. The worst offenders are commutating motors and thermostats in heating appliances, particularly those thermostats which do not have a snap action to interrupt the circuit.

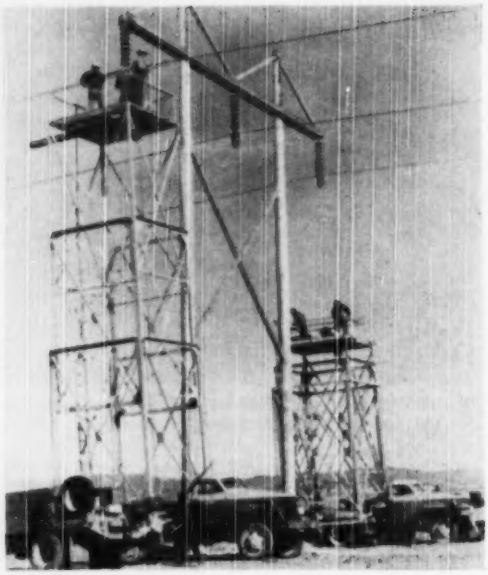
To reduce the effect of domestic appliances, small mica condensers

(*Continued on page 128*)

Transmission line is built by assembly-line method



1 TWO-POLE STRUCTURES are erected in completely assembled condition by special 55-ft crane mounted on 16-ton, 6x6 truck. The portable crane requires no assembly or adjustment in the field, and is operated from the truck cab by one man



2 TELESCOPING three-section elevating towers mounted on 6x6 trucks provide 9x10-ft, vertically adjustable platforms. Using these towers armor-rodding crews averaged 15 min per conductor, including the time required for traveling from structure to structure

Modern Construction Machines Build

Idaho utility races time to finish 73-mile section of 138-kv line in time for winter peak. Elevating platforms, special crane and other machines help build up to 36 structures per day, string and armor 4 miles of 3-ph line

J. F. EMERY
Asst to General Supt
Idaho Power Co, Boise

CONSTRUCTION mechanization played a big part recently in Idaho Power Company's race with time to finish 73 miles of a 138-kv H-frame transmission line in time to carry load for the winter peak. This 73 miles is one section of a line linking the company's new Bliss hydro station with the Boise area.

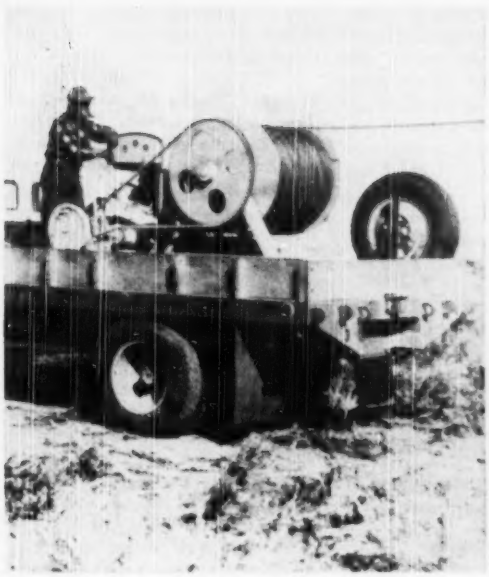
Using a 55-ft heavy-duty truck mounted crane and three truck-mounted elevating platforms, company crews built as many as 36 two-pole structures a day; strung and armor-rodded 4 miles of three conductor line in difficult hilly and sandy terrain. Heavy reliance on portable air compressors, electric generators, mechanical hole diggers, stringing equipment and mobile radio helped to set this record.

Total cost of the line as built for 138-kv operation was $17,703 per mile. Installation of additional insulator units on tangent structures, the only modification required for 230-kv operation, would have resulted in a total cost of $18,124 per mile. A second section of 116 miles from Bliss to the company's American Falls plant is under construction and will be finished about Feb 15.

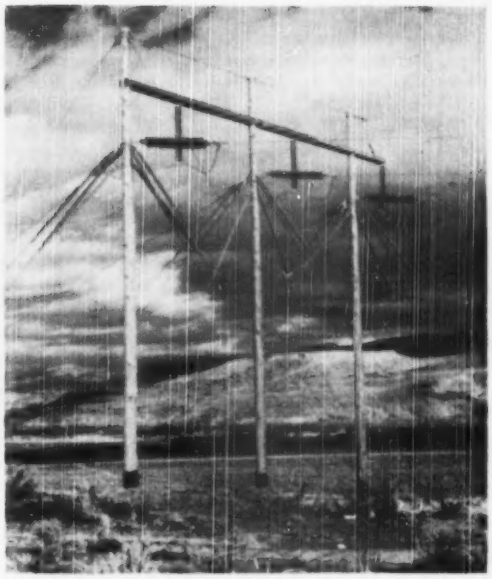
Design

Wood poles and arms were clearly the most economical components for a line in such a sparsely settled area as this. Experience showed that unusually long life (40 yr) could be anticipated here. Pertinent design information for the line, which was completely engineered and constructed by the company, is shown in the accompanying box.

Normal tangent structures use two 65-ft western red cedar class 2 or class 3 poles spaced 20 ft apart and reinforced with "penta"-treated clear fir 40 ft long, with end phase fittings designed for full 20-ft phase to phase separation to allow for possible later conversion to 230 kv. Arms up to 75-ft long were spliced from the 40-ft planks for special spans.



3 POWER-DRIVEN REEL for stringing conductor is one of many mechanical devices used to speed construction on the line. Speaker mounted on truck was part of extensive radio equipment used constantly along the route to effect increased coordination of the work



4 IMPULSE INSULATION level on guyed structures is raised to 2,220 kv by 16-ft, 35,000-lb wood strain insulators. Horn gaps between deadend attachment hardware and grounded head guys provide a predictable path for lightning flashovers

138-Kv Line At Record Speed

Angle and deadend structures were guyed with ½-in. extra-high-strength stranded cables, with two runs used on deadends. Impluse level of these guyed structures (all designed to carry a shield wire) was increased to levels shown (see box) by 16-ft, 35,000-lb wood strain insulators in the guys. Angle and deadend structures also have horn gaps between deadend attachment hardware and grounded head guys. These provide a predictable path for flashovers.

To reduce ground resistance on special structures, anchor rods were bonded with $\frac{5}{16}$-in. stranded cable. Tangent structures have a ground plate on the bottom of each pole. This plate is connected by No. 6 copper wire to shield wire brackets atop the structure and to crossarm and X-brace attachment bolts. The two ground plates on each structure were also connected by a buried tie wire. Shield wires will be provided initially for a mile at each end of each line section. They will be installed eventually on the entire length of both sections.

Hold-down arms were used on a considerable number of tangent structures subject to excessive insulator swing due to moderate uplift at low ambient temperatures. This resulted in a substantial saving compared to deadend structures which would otherwise have been required.

All construction—location, digging, distribution of material, framing in the field, erection, stringing, armor-rodding, and even maintenance—was handled on an assembly-line

Design Data for Idaho Power Co 138-230-kv Line

Length—Bliss-Boise.....73.19 miles
Bliss-American Falls.....116.11 miles
Nominal voltage.....138 kv (spacing suitable for conversion to 230-kv)
Conductor.....450 Mcm copper equivalent ACSR, ultimate strength 28,000 lb
Hardware.....Aluminum suspension clamps
Tapered aluminum armor rods 10 ft long, ½ in. diam
Average length span.....660 ft
Longest span.....2,075 ft (river-rail-highway crossing)
Impulse insulation level.....1,675 kv, no wind, $1\frac{1}{2}$ x 40 micro-seconds positive critical; 1,130 kv, 4-lb wind
Special guyed structures only.....2,200 kv, $1\frac{1}{2}$ x 40 micro-seconds
Structures.....Poles, 65-ft western red cedar, class 2 or 3
Arms, double 4 x 10-in. x 40-ft clear fir plank, "penta"-treated
X-braces, $3\frac{5}{8}$ x $7\frac{1}{2}$-in. "penta"-treated fir
K-braces, $3\frac{5}{8}$ x $\frac{3}{8}$4-in. "penta"-treated fir

basis by company crews. Location of a major part of the line in hilly and sandy terrain required use of all-wheel drive trucks almost exclusively in all these activities.

Because of hardpan and cemented gravel about 90% of the holes required blasting. Digging crews also used a mechanical digger and truck-mounted compressors for earth holes and minor clean-up work. Since it was not possible to coordinate erection crews with the digging, holes were temporarily protected with covers made by nailing together pieces of slab wood. Poles, arms, and other materials were then distributed to the structure site, as near as practicable to the position they would occupy when erected.

Framing Three framing crews of eight men each, with a heavy pickup and a truck with a winch and derrick tripod, assembled the structures on the ground. Each truck carried a 1½-kw generating set to provide a-c power for operation of electric drills, saws, and other similar tools. Jigs which could be applied by tightening a single clamp screw were used to locate holes for field drilling. Ground assembly required field drilling of four holes in the end phase and center conductor fittings. This allowed the K-braces to be completely free of tension or compression, which usually result from different pole diameters if holes are pre-drilled.

Structures were always assembled on the ground in a position to be most easily handled without further spotting by the erecting crane. A complete complement of small tools, socket and ratchet wrenches, sawhorses and framing jacks made the ground assembly a comparatively simple and easy task. About two-thirds of the structures were framed on the site, after considerable delay and excessive costs had resulted from framing at the source of supply. Ground wires and ground plates on the bottom of poles were also installed in the field.

Erection Structures were erected, as shown, by a special 55-ft crane on a 16-ton 6x6 truck. The crane was designed with the base of the derrick mounted on the extreme back of the truck and the boom overhanging the cab so it could traverse highways or city streets without resorting to backing up or maneuvering to make turns. Two hydraulic jacks allow the first section of the boom to be hinged to reduce overall height in traveling position and still permit immediate availability and complete operation of the unit by one man. A back-of-cab winch operates the load line, and a special winch installed on the back of the truck handles the boom. The entire crane assembly sits on top of the truck deck and can be installed or removed in approximately four hours, leaving the truck a conventional heavy duty hauling unit.

After the structure was framed and ready for erection the truck was driven between the poles in the direction of the crossarm. The structure was lifted bodily by a sling, the X-braces eliminating any need for a spreader bar. After leveling and aligning the structure, the backfill was made by a bulldozer and the material compacted with air tampers. With this procedure an erection crew of 30 men consistently erected 30 structures per day, with a maximum of 36 under favorable conditions.

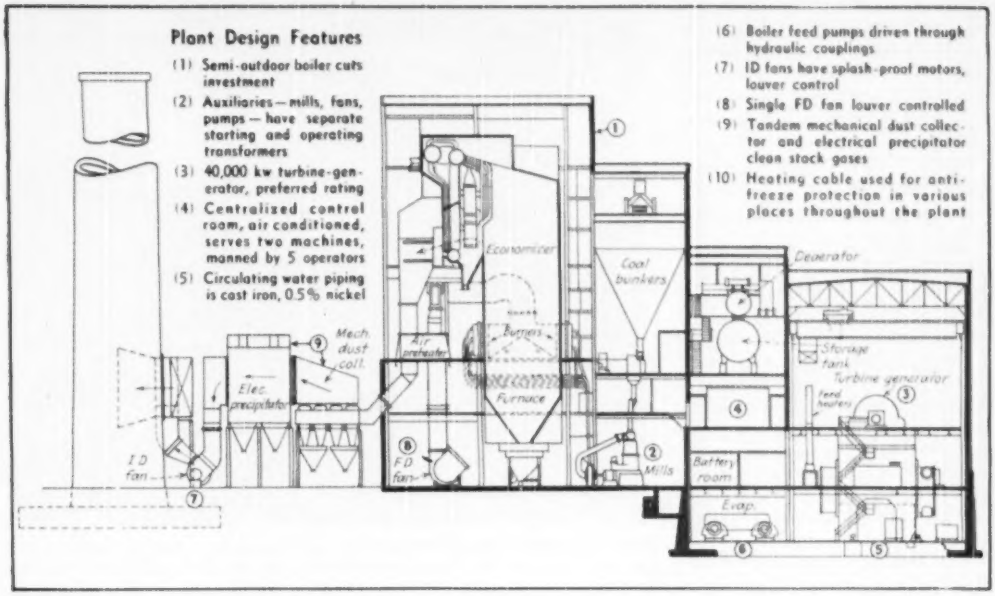
Stringing—Armor-rodding The complete job of stringing and armor-rodding three conductors, starting with insulators in crates and conductor on lagged reels, was done by a stringing crew of 50 men at a rate of over four miles per day. Conductor for stringing the two outside phases was unreeled directly on the ground, where ground conditions would permit, from truck-mounted reels with braking drums. A stringing dolly and insulator string were assembled to the conductor on the ground, and lifted into place at the end of the crossarm by a line from a front end winch passing through a small gin attached to the crossarm. The center insulator and stringing dolly were lifted in the same way, and a through line left hanging down on each side of the X-brace to the ground. A pickup truck dragged the stringing line for the center phase between structures, where it was carried through the stringing dolly by this through line. A special pay-out and take-up reel was then used to string about one mile at a time of the center conductor. This method was also used for the outside conductors over very rough terrain. Sagging was controlled by dynamometers, with continual field checking of actual sag.

Elevator Trucks for Armor Rodding Greatest amount of time was saved by three special elevator trucks used for completing the stringing and armor-rodding operation. Each 6x6 truck chassis provided a platform area approximately 9 ft wide by 10 ft long, adjustable by three telescoping sections from a total height of 49 ft extended, to 19 ft in the traveling position. The sections are elevated simultaneously by a cable arrangement from the regular back-of-cab winch on the truck, with sprockets and chains used to insure synchronism and stability in operation of the tower. Two-way communication from the platform to the truck driver made it easy to adjust tower height as desired by the workmen.

The truck is driven under the conductor after it has been sagged in, and three men on the platform are elevated into position directly under the stringing dolly. A post support or the railing of the tower lifts the conductor, freeing the weight so the stringing dolly can be removed. The conductor and armor rods are then placed in the clamp and the tower lowered enough so the clamp and armor rod take the full weight of the conductor. With the conductor in its normal position the armor rods are twisted on and the end clamp applied. Total time for this complete operation on one conductor, including traveling time from structure to structure, averaged about 15 min.

Several walkie-talkie sets and two-way radio on practically all trucks were in constant use to coordinate the operation. This equipment paid for itself several times over during the course of the job, which could never have been finished in the time available without its use.

Regular maintenance was accomplished on the site by mobile repair units. Equipment was maintained in as nearly new condition as possible, with immediate repair of any accidental damage, no matter how trivial. This placed a high degree of responsibility on the operators, who in turn gave exceptionally good care to the equipment, resulting in very low actual maintenance and an absolute minimum of field failure.


Plant Design Features
(1) Semi-outdoor boiler cuts investment
(2) Auxiliaries—mills, fans, pumps—have separate starting and operating transformers
(3) 40,000 kw turbine-generator, preferred rating
(4) Centralized control room, air conditioned, serves two machines, manned by 5 operators
(5) Circulating water piping is cast iron, 0.5% nickel
(6) Boiler feed pumps driven through hydraulic couplings
(7) ID fans have splash-proof motors, louver control
(8) Single FD fan louver controlled
(9) Tandem mechanical dust collector and electrical precipitator clean stack gases
(10) Heating cable used for anti-freeze protection in various places throughout the plant
Economizer
Coal bunkers
Generator
Mech dust coll.
Elec. precipitator
Air preheater
Burners
Furnace
Storage tank
Turbine generator
Feed heaters
ID fan
FD fan
Mills
Battery room
Evap.

STATION SECTIONAL ELEVATION depicting Port Jefferson plant's more outstanding mechanical and electrical design features

Port Jefferson Station Features Save on First Cost

Generating station has semi-outdoor boiler . . . Plant location on north shore of Long Island has advantage of deep water shipping and cool circulating water . . . Auxiliaries are in duplicate and motor driven . . . Remote controlled switchyard

WILLIAM J. BURNS
Steam Power Engineer
Long Island Lighting Co
Mineola, N. Y.

LATEST ADDITION to electric generation facilities of the Long Island Lighting Co system is the Port Jefferson Generating Station. Basic design of this station adheres to the fundamental concepts that reliability and economical operation are paramount. Here the first machine of an ultimate four-unit plant follows the unit system. A 40,000-kw turbine-generator, supplied by its own 425,000 lb per hr steam generator, delivers power through a single 45,000-kva, 3-ph main transformer to a remote switchyard. This initial installation is predicated on the following: (1) The desire to base load the new machine; (2) the fact that Unit No. 1 would be the most economical machine on the line; (3) the high cost of fuel delivered to the plant site.

In accord with the philosophy of design, the single-boiler-generator-transformer installation incorporates the following noteworthy structural, mechanical and electrical features:

1. An architectural treatment consistent with the residential area in which the plant is located.

2. Use of semi-outdoor boiler installation to save on building cost.

3. Resistance wire utilized as anti-freeze protection for air and water lines.

4. Circulating water system features nickel-content cast-iron piping.

5. Auxiliaries started and operated from separate transformers.

6. Remotely located, fully automatic switchyard unattended.

7. Centralized control room affords convenient operation with the minimum of personnel.

8. Dual dust collectors and 300-ft

stack guard the surrounding area against flyash nuisance.

The single-boiler, single-turbine-generator unit system was selected because of experience gained by a similar installation at Far Rockaway station, also for lower first cost, simplicity and anticipated lower maintenance cost.

Operating Experience

Since going on the line in December 1948, and carrying an average load of 95% nominal rating, the operating performance indicates a sustained heat rate of 11,000 Btu per kwhr in comparison to a calculated value of 10,840. This difference in heat rate is due primarily to the use of oil instead of coal as a fuel, the calculated value being based on coal firing. Oil is being burned because it may be economically used at this time and also because the coal conveying system has not been completed.

The first winter season included the third heaviest snowfall in the area but no operating trouble was experienced.

Resistance heating wire in various outdoor areas prevented freezing of control and instrument lines, and can be credited in part for satisfactory station operation during cold spells.

In a test, load was dropped to as low as 4,500 kw at which time all valves and electrical equipment functioned satisfactorily.

Site Selection

Site for the new plant is approximately 67 acres fronting on Port Jefferson Harbor on the north shore of Long Island. Because terrain near the shore line was steep, a great deal of excavation was necessary to clear a spot for the plant. Consideration at one time, was given to constructing the station parallel to the waterfront to minimize the amount of earth removal. But this scheme was ruled out because the plot was narrow and the unloading dock would have to be a great distance out from the shore line.

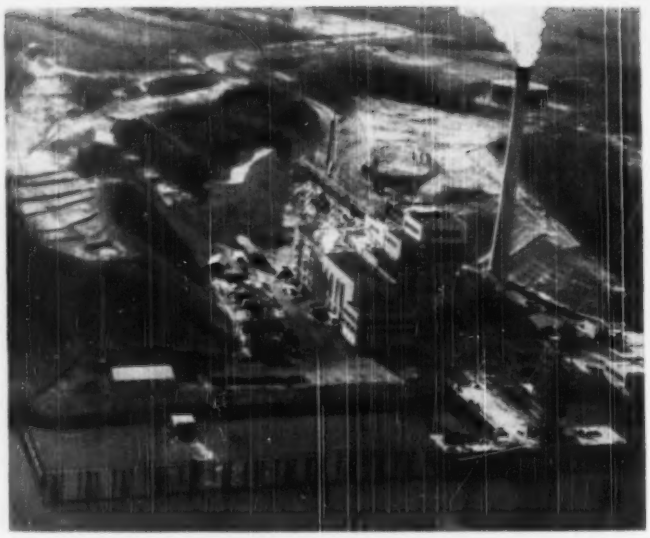
As installed, the main service building has been located adjacent to the water, with future plant expansion to take place away from the harbor side. Finished grade is el 45 ft.

Semi-outdoor Boiler

A semi-outdoor steam generating unit exposed to the elements on three sides was installed on the basis that substantial savings in capital investment would result from lower building costs. The existence of a number of successful installations in locations experiencing inclement and freezing weather demonstrated that operating and maintenance problems incidental to a semi-outdoor boiler were not sufficient handicaps to condemn the basic design.

In addition to the major portion of the boiler casing being exposed, the air heaters, dust collectors and two induced draft fans have been installed outdoors.

Corrugated cement asbestos enclosures are provided at the burner and drum elevations and around the oil heaters. The ash hopper and forced draft fan also have been enclosed. By that arrangement maximum protection for the operating and maintenance personnel and for accessories such as safety valves, gage glasses and traps has been afforded at minimum expense.



PORT JEFFERSON POWER STATION has one 40,000 kw turbine-generator and ultimately will have four units. The installed machine has its own 425,000 lb per hr steam generator

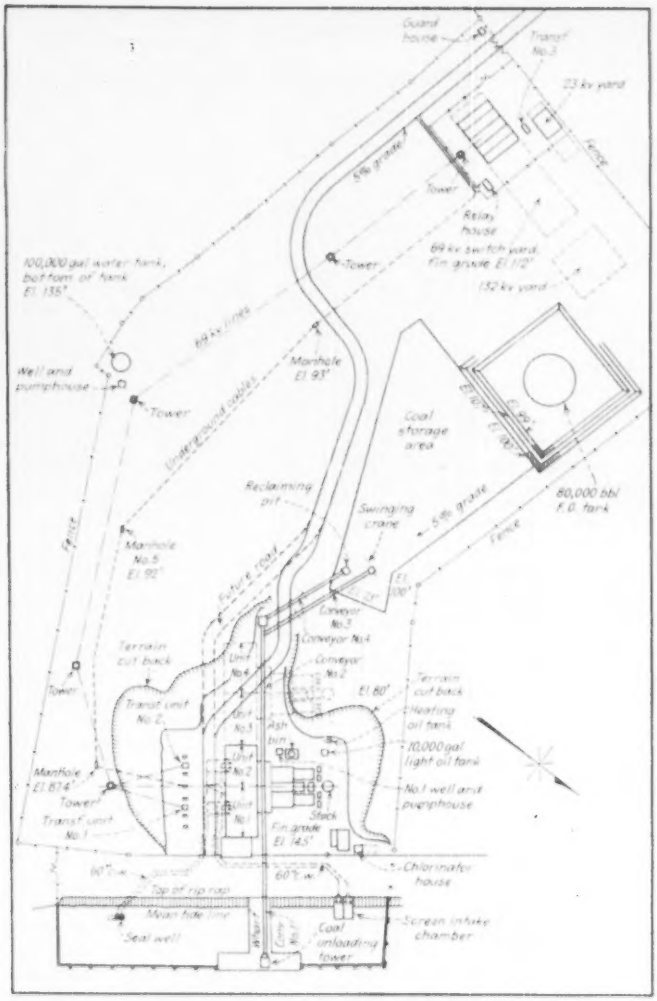
Boiler-Turbine-Generator

The steam generator has a continuous rating of 425,000 lb per hr for 1,350 psig and 955 F at the superheater outlet. Furnace is 21 ft square and 90 ft high. It can be fired tangentially by three pulverized-coal or two oil burners in each of the four corners. Temperature of the steam is regulated by tilting the burners, also by use of dampers as a secondary control. Coal bunker is equipped with high-frequency vibrators after favorable experience at the Glenwood Station. Decision to use these steam conditions was based on high cost of fuel delivered to the dock and the necessity for operating economy and high efficiency.

The first Port Jefferson electric generating unit comprises a 40,000-kw, nominal rated, 21-stage, tandem-compound turbine for throttle steam conditions of 1,250 psig and 950 F. It is direct coupled to a 47,058-kva, 3,600-rpm, 3-ph, 60-c, 0.5-psig hydrogen-cooled generator with a direct-connected exciter and amplidyne voltage control. Consideration was given initially to a 35,000-kw generator but the 40,000-kw unit was selected on the basis of (1) it being a preferred standard listing and (2) reduced overall cost.

Auxiliary Equipment

Auxiliary equipment, that upon failure would cause station shutdown or severe damage, was duplicated for reliability. Two boiler feed pumps have been installed; each with a 1,500-hp motor and driven through hydraulic coupling. Each has been designed for 100% plant capacity, permitting one pump to be in service



OVER-ALL SITE PLAN indicates steep grade of terrain, from el 14 ft at power plant to 112 ft at switchyard, in a distance of approximately 1500 ft. Site covers about 67 acres.

while the second pump is in reserve.

Duplicate, full-capacity condensate pumps have been provided. In addition, two half-capacity, constant-speed circulating water pumps have been installed even though a single full-capacity, two-speed system was estimated to require lower initial investment. Operating convenience and ability to clean one-half the divided water-box condenser, and protection against complete plant outage, however, more than justified the dual pumps.

Two single-speed, half-capacity, inlet-louver-controlled induced-draft fans have been provided to protect against complete outage in the event of fan failure, and to facilitate maintenance. Splash-proof motors were chosen on the basis of lower prices than totally enclosed motors, and of successful operation in comparable installations.

Only one forced-draft fan has been provided. However, no sacrifice in reliability is anticipated, for the large, slow-speed, louver-controlled unit is located indoors and is expected to function satisfactorily.

Air soot blowers were chosen on the basis of experience gained at Glenwood Power Station where both air and steam blowers were in service, and on the reduced boiler water make-up required if air blowers were utilized. Two 500-lb compressors supply the soot blowers.

Automatic sequential equipment was installed for the soot blowers so that the operators would not need to leave the control room to operate the equipment. This feature has reduced the number of operators required and kept them out of inclement weather.

For the plant make-up water system, no pre-treatment system has been installed. Raw well water is deaerated and evaporated for use in the main boiler. This arrangement proved successful at Glenwood Power Station where well water analysis was similar.

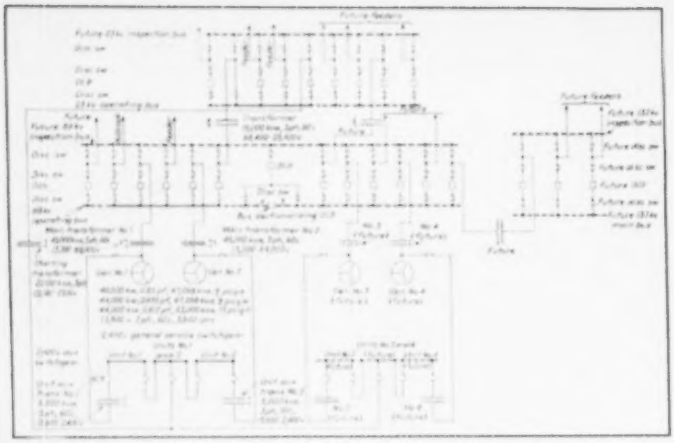
Anti-Freeze Protection

To maintain the effectiveness of the pneumatic controls, air soot blower system and miscellaneous water lines under winter conditions, all exposed control and water piping subject to freezing has been protected by means of resistance wiring. Single-conductor 19 Awg lead-covered heating cable suitable for 220-v service has been utilized in units of 120 linear feet of dual run, providing 60-ft wrapping lengths. Each length provides a heating effect of approximately 16-20 w per ft of run when supplied with 800 w. Thermostats have been provided to hold air and water at regulated temperatures above freezing.

Circulating Water System

Steam condenser has a divided water box. Individual 60-in. diam inlet and outlet pipes with 36-in. diam condenser and pump connections are installed to meet the circulating water requirements of the first turbine-generator unit. A duplicate installation will serve the second unit. Condensing water from the harbor has a temperature ranging from 78 to 32 F. The intake and discharge in the harbor are 500 ft apart, and no trouble has been experienced with recirculating warm water.

All circulating water piping is cast iron having 0.5% nickel content for protecting against salt water corrosion. Cast iron pipe was selected



ELECTRICAL DIAGRAM for existing and future installations. Note that auxiliaries are started on 2,000 kva transformer fed from 23 kv system and are operated from 5,000 kva transformer connected directly to generator main leads. Each generator is self-sufficient when it is producing, main 45,000 kva transformer handling load. No house generator is required

Vital Statistics

Port Jefferson Station

Turbine Rating	
Nominal kw	40,000
Capability, kw	44,000
Generator Rating, kva	
0.85 pf, 0.5 psi H	47,058
0.85 pf, 15.0 psi H	54,117
Steam, throttle	
Pressure, psig	1,550
Temperature, F	950
Boiler Capacity	
Continuous, lb per hr	425,000
Fuel Storage	
Coal, tons	70,000
Oil, bbl	80,000
Heat Rate, Btu per kwhr net (design)	
At 40,000 kw, 1.5 in. Hg BP	10,840

over concrete tunnels on the basis of lower initial investment, whereas pipe size was set by an analysis of the cumulative fixed charges and the smallest size practicable for manual cleaning if such became necessary.

Fixed intake screens and travelling screens, which are made principally of galvanized steel, are afforded cathodic protection by a selenium rectifier and a graphite anode ground bed system.

Auxiliary Power

Normally, the electrical supply for auxiliaries is taken from a 5,000 kva, 3-ph auxiliary transformer tied in to the main generator leads. This installation makes the station self-sufficient after it is in operation. For starting the auxiliaries, power is supplied by a 2,000-kva, 3-ph transformer fed from the 23-kv system.

In general, all auxiliary equipment motors 100 hp and above are operated on 2,400-v, 3-ph, 60-c circuits, from 1 to 100 hp on 440 v, 3-ph, and under 1 hp on 110 v, 1-ph.

All 2,400-v and 430-v switchgear are the indoor, factory fabricated, metalclad, air circuit breaker, cubical design, and insofar as possible, have been centralized in one room. Most of the cabinet type of load centers have been located in the switchgear room; others are installed at points as required throughout the plant.

Switchyard

Output from the generator to the main 45,000-kva transformer is carried at 13.8 kv by copper buses run in an isolated phase structure from the generator to the building wall. From the building wall to the transformer, a distance of approximately 100 ft, four 1,500 Mcm cables per phase are interlaced in a concrete encased and drained Transite underground duct system. The cables used have oil base compound, corona resistant insulation, Neoprene jackets and copper shielding tape, and are suitable for a 15-kv ungrounded system. In comparison to the rated output of the generator, these cables have a slight over-capacity. If one of the cables should develop trouble the other three can carry 45,500 kva or almost the rated output of the main generator.

On the plant property are 23-kv and 66-kv switchyards, and provisions for a 132-kv yard. These switchyards are located approximately 1,500 ft from the generating station on an adjacent hill having a section at a finished grade of 112 ft. Terrain necessitated this arrangement.

Transmission from the 45,000-kva transformer to the 66-kv switchyard is over a steel tower installation supporting two circuits.

The 23-kv system is tied into transmission lines from other generating plants. From this system the Port Jefferson area is fed radially.

Normal transmission on the 66-kv system is over a single line approximately 9 miles long, extending from the power station switchyard to the new 66-kv switching substation at Holbrook.

Centralized Control

An air-conditioned room has been provided for the operation of Unit No. 1 and will be extended for the second unit. Centralizing control in this room permits operation of the boiler, turbine, and their auxiliaries with a minimum of personnel, only five operators per shift under the direction of one watch engineer being required for two generating units.

Panels mounting the generator controls are located in the same room. Consequently, it will be necessary to station a man at a turbine-generator only during periods of starting; at all other times the unit will be operated from the control room. Adjacent to the generator panels are the control panels for the plant, 23-kv and 66-kv switchyards and supervisory controls for Holbrook Substation.

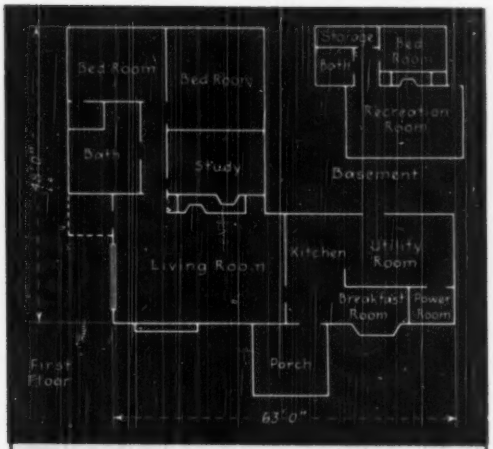
To make the station an asset to the residential area, gray manganese spot face brick exterior walls, com-

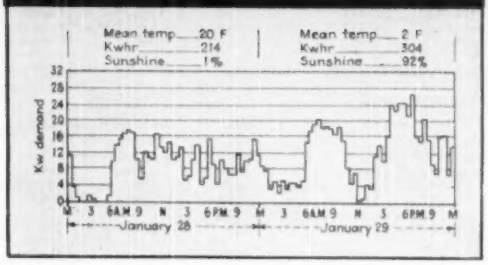
(Continued on page 123)

CORRECTION

In the January 2 issue of ELECTRICAL WORLD an error was made in designating the authors of the article "Utility and Developer Build Low-Cost Underground System." Author C. E. Nelson's name was incorrectly given as E. E. Nelson.

EIGHT-ROOM RANCH-TYPE HOME





HALF-HOUR DEMANDS for electric radiant heating panel system in eight-room, ranch-type home show how load fits into system curve. The total installed heating capacity is 30.7 kw

Construction Details

One-story ranch-type
Solid brick wall
Blanket insulation on walls
Ceiling fully insulated
All but one large solar type window in living room equipped with storm windows
Floor area—2,746 sq ft
Building volume—22,000 cu ft
Heat loss (0 to 70 F)—78,000 Btu/hr
Heating system—Conductive rubber panels

Ceiling Panel Layout

Living room & entry	503 sq ft	5,888 watts
Kitchen, utility, brk. room	397 sq ft	5,496 watts
Study	176 sq ft	1,632 watts
Bed room	228 sq ft	2,176 watts
Bed room	180 sq ft	1,792 watts
Bath & hall	105 sq ft	1,260 watts
Powder room	24 sq ft	528 watts
Porch	121 sq ft	1,904 watts
Basement	1,012 sq ft	6,056 watts
Total	2,746 sq ft	30,678 watts

Operating Data

Month	Kwhr	Kw	Deg Days	Kwhr./°Day
December	8,832	30.6	1,074	8.2*
January	7,284	26.8	1,134	6.4*
February	5,059	23.6	1,039	4.9
March	3,494	25.8	854	4.4
April	2,019	18.6	515	3.9
May	578	17.4	184	3.2

* See text for explanation of these higher figures

Will Electric Heating Work In Northern Climes?

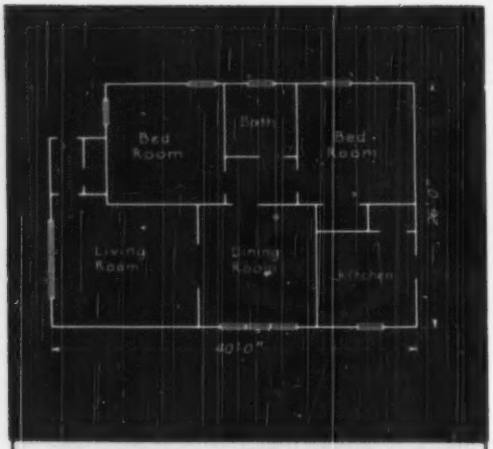
Author Freyder answers this question with test data from three Chicago radiant heating installations

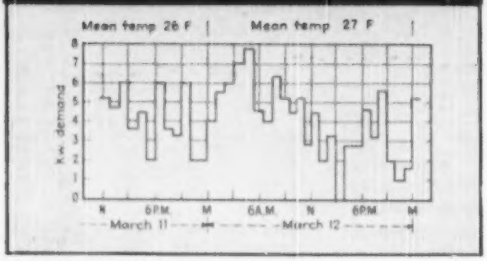
G. G. FREYDER
Engineer, Sales Service Department
Commonwealth Edison Co, Chicago

DEVELOPMENTS in recent years have aroused increasing interest in the use of electricity for space heating. This trend has been more noticeable in certain sections of the country, particularly where exceptionally low electric rates and comparatively moderate climates reduce heating requirements. However, there has also been an interest in electric heating in Chicago, and three radiant panel installations were made during the past year, two residential and one office. In order to gather data, meters were installed on the three jobs to record the half hour maximum demands and the kwhr use.

Construction details, performance data, and demand curves of each installation were prepared. Demands for the week of Jan 30th to Feb 5th were selected in preparing curves for two installations, because this was the coldest period of the 1948-49 heating season. The other installation was not in operation at that time so it was necessary to use data for a week in March.

One residential installation consists of radiant ceiling panels of conductive rubber. The house is a





INSTALLED CAPACITY below calculated requirements for five-room bungalow gave lower demand and better load factor than anticipated, with ample capacity. Chart shows half-hour demands

FIVE-ROOM BUNGALOW

Construction Details

1½ Story bungalow
Solid brick wall
Walls uninsulated
Ceiling fully insulated
Floor (basement ceiling) insulated
Storm windows
Foundation 40'-0" x 26'-0"
Building volume 8,840 cu ft
Heat loss (—10 to 70 F) 47,500 Btu/hour
Heating system—Glass panels

Heating Layout

Living room	2 panels	2,000 watts
Dining room	2 panels	2,000 watts
Bed room	2 panels	2,000 watts
Bed room	1 panel	1,000 watts
Bath room	1 panel	1,000 watts
Kitchen	1 panel	1,000 watts
Total	9 panels	9,000 watts

Operating Data

Period	Kwhr	Deg Days	Kwhr/°Day
3/12 to 3/18	686	271	2.5
3/19 to 4/ 1	815	538	1.5
4/ 2 to 4/11	536	204	2.6
4/12 to 4/18	420	145	2.8
4/19 to 5/ 4	356	144	2.5
5/ 5 to 5/17	223	75	3.0
5/18 to 5/27	233	84	2.8

House heating with electricity costs more than

one-story, brick, ranch-type, containing approximately 22,000 cu ft, including living space in basement. Heat loss calculated with design conditions of 0 to 70 F is 78,000 Btu per hour. Total installed heating capacity is 30.7 kw. Heating requirements of this home should not be considered as typical of an average house. The home is of unusual design including large glass areas.

Meter readings were obtained from Dec 1, 1948, to June 1, 1949. The kwhr use per degree day during December and January was much greater than for the other months. This was probably caused by wet plaster, incomplete installation of storm windows, and insufficient insulation over some of the panels. Correction of these conditions gave kwhr figures for February and March which are probably more typical.

In addition, the owner had made an attempt to put into practice economies offered by the electric heating system. The temperature in unoccupied rooms was lowered by means of the individual room thermostats. Also time clock switching was installed to turn off some panels between midnight and 5 AM. Such practices are not difficult and may be the answer for most efficient use of electric heating.

Kilowatt hour requirements have not been consistent. Average use per degree day has decreased each month. Using 4.4 kwhr per degree day average for March as a basis for estimating, the seasonal heating costs for 6,300 degree days will be 27,720 kwhr or $544.40. The heating factor on this basis is 0.2 kwhr per degree day per thousand cu ft, which is equivalent to that being quoted for a well insulated house. The customer's acceptance of this form of electric heating is indicated by his recommending the same system for a business associate's new home now under construction. However, another season's performance data will be necessary before definite conclusions can be reached with regard to cost of heating this home electrically.

Five-Room Bungalow

Data were also obtained on another home, a 1½ story, five-room, brick bungalow heated with glass panels. This home was previously heated by an oil fired hot water system at a cost of approximately $185.00 per year. After the panels were installed the first floor ceiling was insulated with rock wool and the basement ceiling with aluminum foil. A rough check indicates heat loss to be about 48,000 Btu per hour at design conditions of —10 to 70 F.

Installation of the panels was com-

OFFICE INSTALLATION

Construction Details

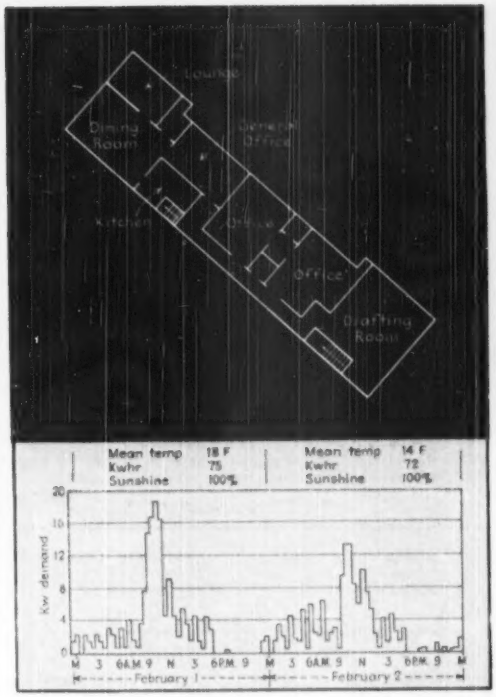
Third floor office (3 story building)
Brick wall
Wall and ceiling fully insulated
Storm windows
Total floor area 1,600 sq ft
Heating system—Conductive rubber panels

Ceiling Panel Layout

Lounge	108 sq ft	1,600 watts
Dining room	260 sq ft	2,750 watts
Wash room	14 sq ft	615 watts
Kitchen	98 sq ft	615 watts
Hall	127 sq ft	1,275 watts
General office	175 sq ft	2,225 watts
Private office	232 sq ft	2,720 watts
Private office	186 sq ft	1,915 watts
Drafting room	423 sq ft	4,960 watts
Total	1,623 sq ft	18,675 watts

Operating Data

Month	Kwhr	Kw	Deg Days	Kwhr/°Day
January	1,674	11.7	1,134	1.5
February	1,965	18.9	1,039	1.9
March	739	12.1	854	.86
April	228	10.2	515	.44
May	18	2.4	184	.01



HALF-HOUR DEMANDS on office installation show effect of turning off heat at nights and on week-ends. Seasonal heating cost is estimated at $125.40, based on average cost of 1.9c per kwhr

with fuel. But does it cost too much more?

pleted around March 1st. Record of electric energy used for heating was obtained from March 11th to June 1st. Use of electricity during this period was very consistent and varied directly with the number of degree days. The figures indicate an average of 2.5 kwhr per degree day, and a heating factor of 0.28 kwhr per degree day per thousand cu ft. This figure of 0.28 seems reasonable for the insulation and construction of the home. Some authorities have suggested using 0.2 kwhr per degree day per thousand cu ft for a well insulated house. Using the above figures as a basis for estimating, the seasonal heating requirements will be 15,750 kwhr and the cost $315.00.

Economies in heating are to be had with this system, which are not possible with the conventional fuel burning heating plant. The electric radiant panels are so installed that no heat is lost in the basement and zone heating is made possible with individual thermostats in each room.

Office Installation

In still another heating installation in Chicago, conductive rubber electric radiant heating panels were installed in a third floor office. This application was somewhat different, and the panels can be considered as supplementary heat. The lower two floors are heated with a steam boiler, some heat escaping to third floor.

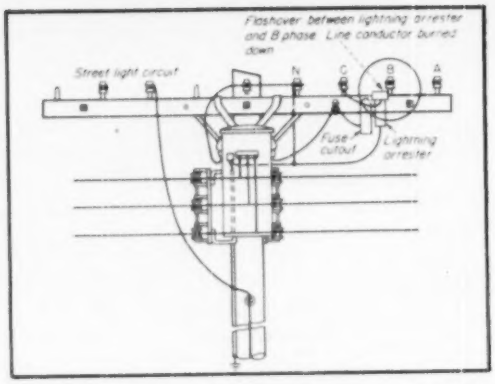
Heating in each room is individually controlled by a thermostat as is done in the other two electric heating installations. During the night and on week ends the thermostats are turned down. Sufficient heat filters in from the floors below to maintain temperatures well above freezing. Thermostats are then set for desired room temperatures when the offices are occupied during the day.

It is difficult to compare heating requirements of this office with other electric panel installations, because it is primarily supplementary heating. Energy used from January to June during the past heating season indicates a seasonal use of 6,600 kwhr for heating at a cost of $125.40. This estimate is based on an average heating season of 6,300 degree days.

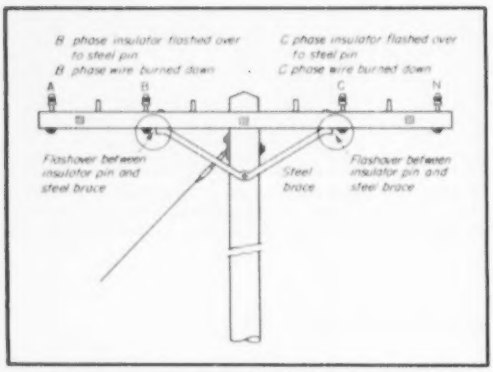
This application appears to be practical. There was a considerable saving on installation costs. Extension of the existing heating system to the third floor would have been much more costly than the electric panels. Operating costs, although higher than for a conventional heating plant using other fuels, do not seem excessive. Evaluating the advantages of zone control, cleanliness, and comfort of radiant heat the additional cost can be justified.

Pole-Top Post Mortems Spot Trouble-Prone Arrangements

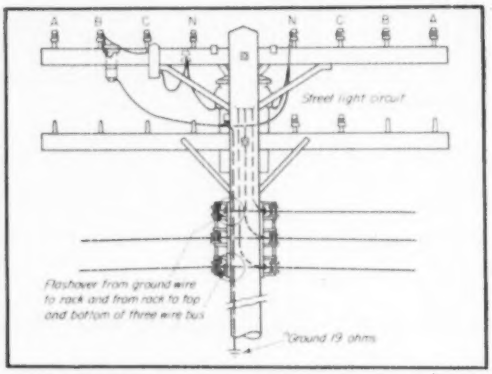
J. F. HENNESSY
Consolidated Gas Electric Light & Power Co
Of Baltimore



1. TROUBLE—B phase conductor burned down as a result of flashover from B phase to a lightning arrester connected to C phase. **CAUSE**—Phase-to-phase clearance was substantially reduced in this case when the C phase lightning arrester was installed too close to the B phase pin. Area involved in flashover is shown circled


B phase insulator flashed over to steel pin
B phase wire burned down
C phase insulator flashed over to steel pin
C phase wire burned down
A
B
C
N
Flashover between insulator pin and steel brace
Steel brace
Flashover between insulator pin and steel brace

4. TROUBLE—B phase and C phase conductors burned down by phase-to-phase flashover through steel brace. **CAUSE**—Effective clearance between B and C phases reduced by steel brace on line arm



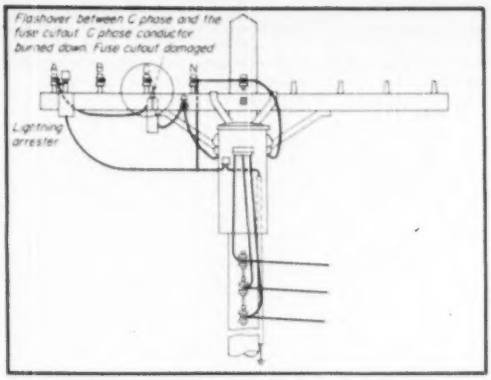
5. TROUBLE—Flashover from lightning arrester ground to 120/240 v conductors. **CAUSE**—Clearance of 1 inch between arrester ground and the rack supporting 120/240 v secondary wires

How the Baltimore company has reduced wire burndown and equipment damage due to lightning on its 4-Kv system by the case study method is shown in accompanying sketches

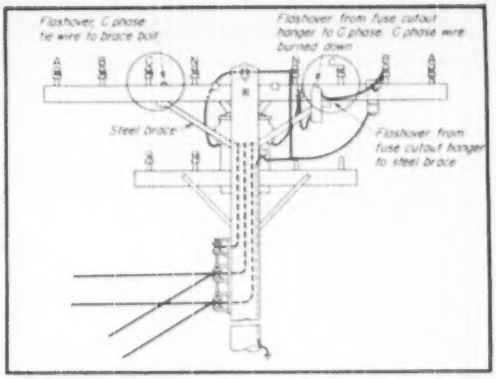
POST MORTEM pole-top inspection has reduced by about one-third the incidence of wire burndown due to lightning on our 4-kv distribution system. This study, started by our Lightning Protection Committee in 1931, has spotted trouble-prone pole-top arrangements and, over the years, inspired corrective modifications in our "Construction Standards". The inevitable result has been an increasingly better performance of our 4-kv distribution circuits.

Field inspectors were generally able to diagnose the cause of trouble by reconstructing the path of flashover. Their conclusions were based on flash spots noted on conductors, equipment and hardware, supplemented when necessary by interviews with the members of the repair crew.

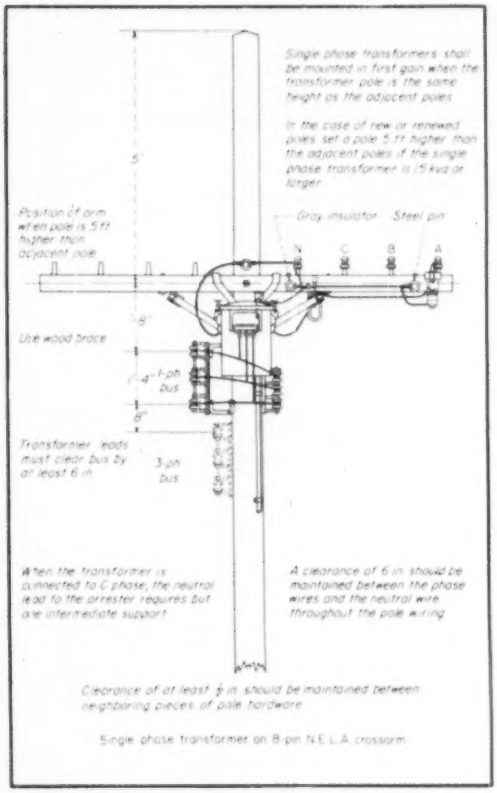
What our field inspectors found and what we did to improve our construction practice is typified by the sketches on these pages, some of which are based on reports filed by our field investigators and some being taken from our "Construction Standards".


Flashover between C phase and the fuse cutout. C phase conductor burned down. Fuse cutout damaged
Lightning arrester
A
B
N

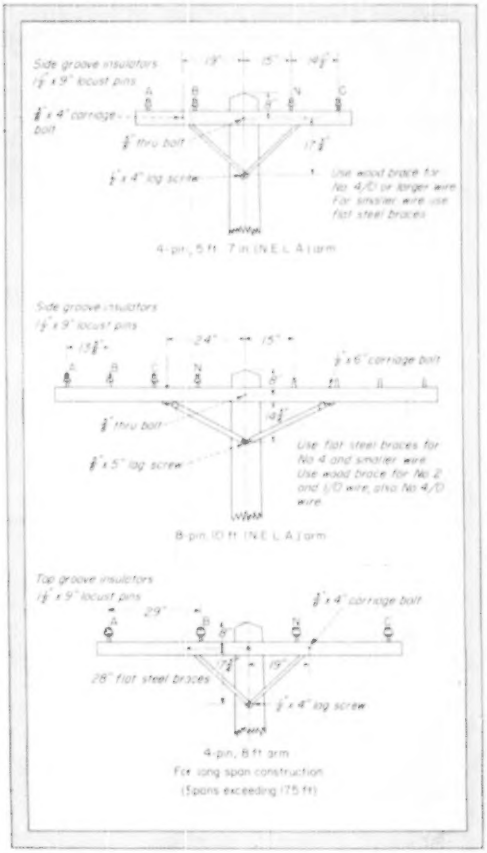
2. TROUBLE—C phase conductor burned down as a result of a flashover from C-phase to a fuse cutout connected to A phase. **CAUSE**—Phase-to-phase clearance was reduced substantially when A phase cutout was placed adjacent to the C phase insulator pin. Causes were determined by field inspectors reconstructing flashover paths


Flashover, C phase tie wire to brace bolt
Flashover from fuse cutout hanger to C phase. C phase wire burned down
Steel brace
Flashover from fuse cutout hanger to steel brace

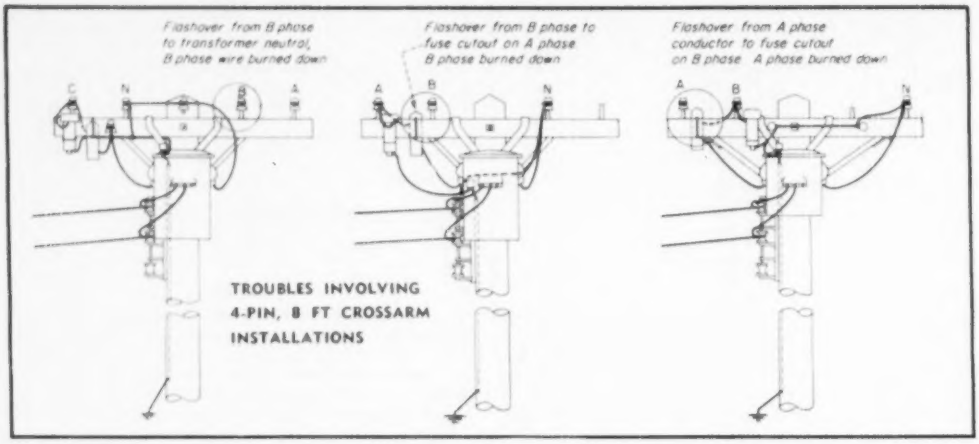
3. TROUBLE—C phase conductor burned down because of a flashover between B phase fuse cutout and the C phase conductor on each side of the crossarm. **CAUSE**—Phase-to-phase clearance reduced by the steel brace and by placing the fuse cutout, connected to B phase, so that its hanger was in contact with the steel brace


Single phase transformers shall be mounted in first gain when the transformer pole is the same height as the adjacent poles
In the case of new or renewed poles set a pole 5 ft higher than the adjacent poles if the single phase transformer is 15 kva or larger
Position of arm when pole is 5 ft higher than adjacent pole
Gray insulator
Steel pin
N
C
B
A
5'
9"
Use wood brace
4" 1-ph bus
6"
Transformer leads must clear bus by at least 6 in.
3-ph bus
When the transformer is connected to C phase, the neutral lead to the arrester requires but one intermediate support
A clearance of 6 in. should be maintained between the phase wires and the neutral wire throughout the pole wiring
Clearance of at least ½ in. should be maintained between neighboring pieces of pole hardware
Single phase transformer on 8-pin N.E.L.A. crossarm

6. 4-KV POLE-TOP DESIGN incorporating corrective practices derived from investigations such as those illustrated, appear in this excerpt from "Construction Standards". This arrangement illustrates steps taken on 8-pin, 10-ft crossarms to reduce outages due to conductor burndowns at transformer installations. It will be noted that clearance between phase wires and neutral should be 6-in. min


Side groove insulators
⅝" x 9" locust pins
⅝" x 4" carriage bolt
⅝" thru bolt
⅝" x 4" lag screw
Use wood brace for No. 4/0 or larger wire. For smaller wire use flat steel braces
4-pin, 5 ft 7 in N.E.L.A. arm
Side groove insulators
⅝" x 9" locust pins
⅝" x 6" carriage bolt
⅝" thru bolt
⅝" x 5" lag screw
Use flat steel braces for No 4 and smaller wire. Use wood brace for No 2 and 1/0 wire, also No 4/0 wire
8-pin 10 ft N.E.L.A. arm
Top groove insulators
⅝" x 9" locust pins
⅝" x 4" carriage bolt
28" flat steel braces
⅝" x 4" lag screw
4-pin, 8 ft arm
For long span construction
(Spans exceeding 175 ft)

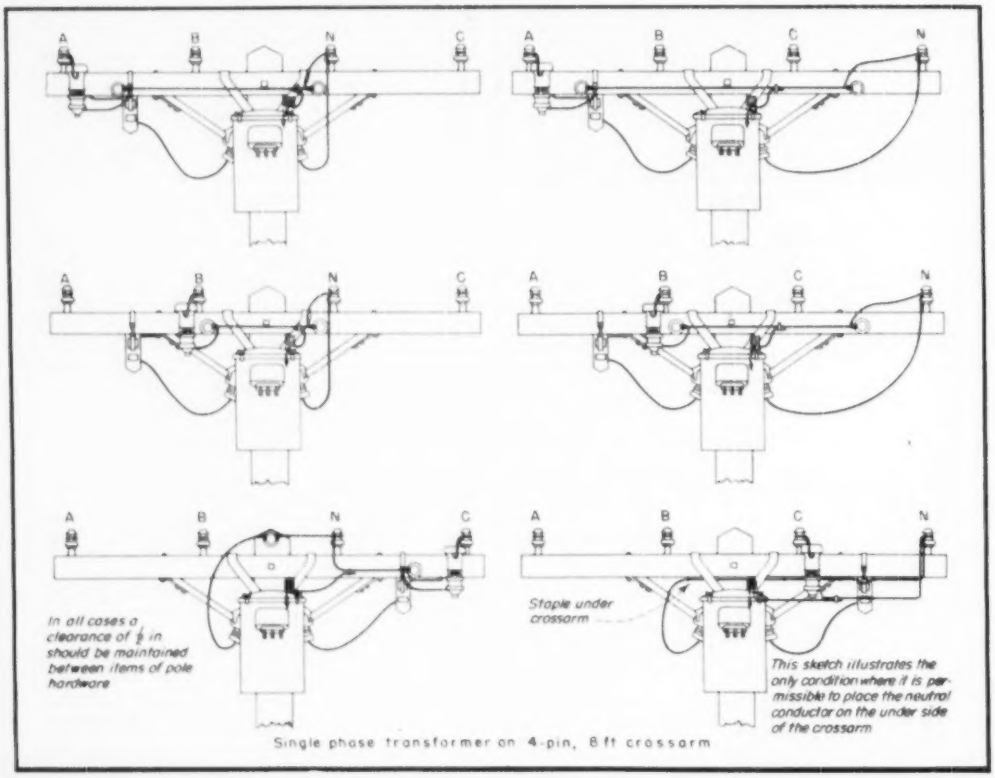
KEY TO DIMENSIONS of standard crossarm assemblies used on 4-kv-lines. Transformers are installed on the line crossarm and applicable to the crossarm arrangements shown on these pages


Flashover from B phase to transformer neutral, B phase wire burned down
Flashover from B phase to fuse cutout on A phase. B phase burned down
Flashover from A phase conductor to fuse cutout on B phase. A phase burned down
TROUBLES INVOLVING 4-PIN, 8 FT CROSSARM INSTALLATIONS

1. TROUBLE—B Phase conductor burned down by flashover to neutral transformer lead. **CAUSE** — The excessive slack in the transformer lead had reduced clearance to such an extent between the lead and B phase

2. TROUBLE—B phase conductor burned down by flashover from B phase to a fuse cutout connected to A phase. **CAUSE**—Fuse cutout located so that it cleared B phase conductor by 3 in.

3. TROUBLE—A phase conductor burned down as a result of a flashover between A phase wire and the B phase fuse cutout. **CAUSE**—Fuse cutout located so that it cleared A phase conductor by 4½ in.


In all cases a clearance of ½ in. should be maintained between items of pole hardware
Staple under crossarm
This sketch illustrates the only condition where it is permissible to place the neutral conductor on the under side of the crossarm
Single phase transformer on 4-pin, 8 ft crossarm

4. STEPS TAKEN TO REDUCE OUTAGES due to conductor burndowns at transformer installations on 4-pin, 8-ft crossarms

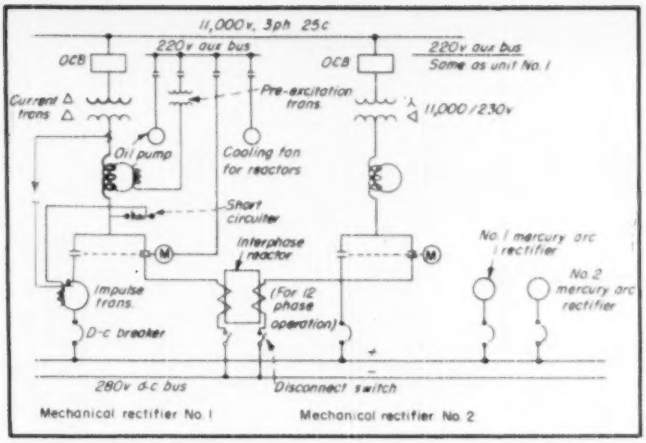


FIG 1—SCHEMATIC WIRING DIAGRAM of Buffalo Electro-Chemical Co installation of two mechanical rectifier units in parallel with two mercury arc rectifiers of the ignitron type. Each unit is rated 3,500 amp, 280 v d-c, or 980 kw, and has an efficiency above 96%

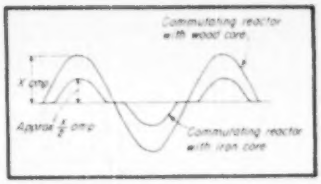


FIG 2—LIMITATION of short circuit current with commutating reactor assists main a-c breaker in interrupting short circuit

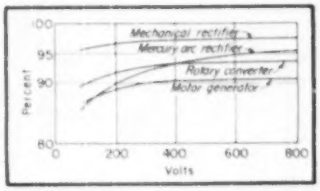


FIG 3—COMPARISON shows mechanical rectifier efficiency high compared to other types, especially in the lower voltage ranges

Mechanical Rectifier Completes Year's Operation

Here's how a chemical plant pioneered the installation of two mechanical rectifiers featuring high efficiency and space saving. Units operate successfully in parallel with two mercury arc rectifiers and have been operated in parallel with an m-g set

OTTO JENSEN
Manager, Rectifier Div
ITE Circuit Breaker Co
Philadelphia, Pa.

HISTORY was made in the conversion equipment field February 8, 1949, when the first large mechanical rectifier built by I-T-E Circuit Breaker Co. was placed in service by the Buffalo Electro-Chemical Co, Buffalo, New York. This mechanical rectifier is rated 3,500 amp, 280 v d-c or 980 kw, and it has an efficiency of better than 96%. A twin unit of the same rating was placed in operation four weeks later.

The two units are operating successfully in parallel with two mercury arc rectifiers of the ignitron type, and have furthermore been operated in parallel with a motor-generator set. The schematic diagram of main connections is shown in Fig 1. Each unit is fed through an OCB from an 11,000-v, 3-ph, 25-c bus. A 3-ph transformer steps down the primary voltage to proper rectifying voltage. In each secondary transformer lead is inserted a commutating reactor whose duty it is to provide a step of zero value, and of a duration of 1.35 ms, each time commutation is completed between two adjacent phases. This zero current step permits arc free opening at the contacts and an instantaneous load variation between zero and 7,500 amp per unit. Connected directly to the commutating reactors are the a-c terminals of the contact mechanism. The positive terminal is connected through an impulse transformer, a shunt and a high speed breaker to the positive bus. The negative terminal is connected through an interphase reactor, and a disconnect switch to the negative bus.

Each contact mechanism contains six contacts, three positive and three negative. The three positive contacts are spaced 120 electrical degrees apart, and the three negative contacts are similarly spaced.

Each pair of positive and negative contacts connected to the same phase are spaced 180 electrical degrees apart, resulting in a 3-ph bridge connection, providing 6-ph operation from the 3-ph transformer. The primary windings of the two transformers are offset 60 electrical degrees from each other, as one transformer is connected wye-delta and the other

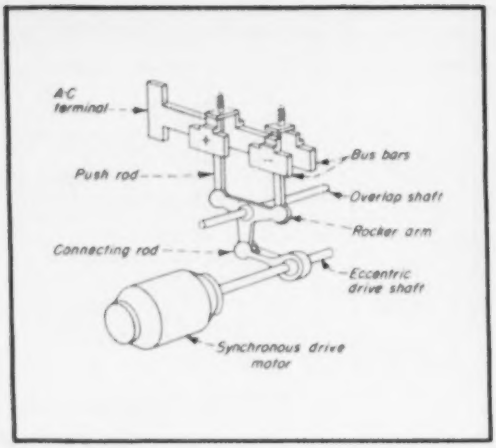


FIG 4—CONTACT MECHANISM for one phase. Three contact mechanisms driven by a common motor are used in a 3-ph mechanism. Eccentric shaft is driven by a special synchronous motor

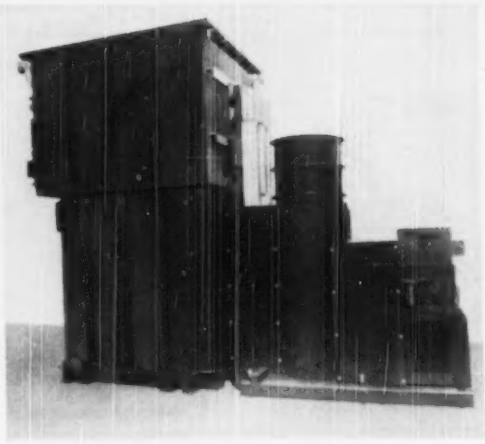


FIG 5—TRANSFORMER, commutating reactor, and contact mechanism of mechanical rectifier. Two units like these are used for the manufacture of hydrogen peroxide—a constant current load

delta-delta. Therefore 12-ph operation is obtained when both units are operating in parallel, and for this reason, the interphase reactor is provided in the negative leads of the two units.

Protection of each unit is provided as follows. Three CO relays equipped with time delay and instantaneous feature are operated by 3 CT on the 11,000-v side. The time delay feature is set at 1.75 times normal rating with a 30-c delay, and is arranged to trip the high speed d-c breaker and after this breaker is tripped, the a-c breaker. The instantaneous feature is set at four times normal rating and arranged to trip the a-c breaker directly. High speed d-c breaker has reverse current trip only.

In case of a backfire in the contact mechanism, which can only occur for two reasons, 1, when each unit is operated above 7,500 amp and 2, if the a-c voltage dips below 40-50% of normal voltage, a short circuit device will short circuit both the a-c and d-c sides of the contact mechanism. The short circuit device operates in approximately 1 ms. This high speed operation limits the damage to one or at the most two contacts, which should be replaced before the rectifier is re-started, if full overload capacity of the machine is required. The operation of the short circuiter is obtained by means of the impulse transformer. As long as the a-c input and d-c output is balanced, the core of the impulse transformer is saturated in the negative direction by means of a d-c bias winding, but if the balance of input and output is disturbed, the core changes from negative to positive saturation and a tripping impulse of very short duration is delivered to the trip coil of the short circuiter.

After operation of the short circuiter, any parallel machines on the d-c side are disconnected by the high speed d-c breaker, operated by the reverse current trip feature, leaving only the a-c side short circuited. As the commutating reactors are still in the circuit, the resulting a-c short circuit current is limited to approximately $\frac{1}{3}$ the value which would be obtained without commutating reactors. This short circuit is easily interrupted by the main a-c breaker, as the current remains at zero value for an appreciable time every $\frac{1}{2}$ cycle, as shown in Fig 2.

The control circuit of the a-c breaker, d-c breaker and all auxiliaries are properly interlocked to prevent faulty operation by the operating personnel.

The contact operating mechanism for one phase is shown schematically in Fig 4. The eccentric shaft is driven by a synchronous motor of special design. The rotating mass is kept to a minimum and the pull out torque is exceedingly high. Accelerating test from 3,000 to 4,200 rpm in one second did not cause the motor to fall out of step.

The moving contact is $1\frac{1}{2}$ in. diam, $\frac{5}{16}$ in. thick and is made of silver. The contact spring exerts a pressure of 200 lb, 100 lb against each stationary contact. The two stationary contacts, which are equipped with silver inlay contact surfaces, the moving contact and contact spring are assembled in a phenolic housing, forming a contact unit which can easily be replaced. Total replacement time of all six contacts is less than 5 min. No definite information about contact life is available yet, but one unit ran on 24 hr duty for nine consecutive weeks loaded to 5,000 amp with very little contact wear. Except for transformer troubles, the operating experience gained with the Buffalo units has been gratifying.

In installing the two mechanical rectifiers, the Buffalo Electro-Chemical Co has again pioneered in the conversion field. Mercury arc rectifier No. 1, in the same plant, was the first ignitron rectifier placed in electro-chemical service. Without such pioneering, new equipment could not be made available and progress would come to a standstill. Thanks to the management of the Buffalo Electro-Chemical Co, a new conversion means in the 50-400-v class has had an opportunity to prove its value to American industry.

Accuracy of Type FR-1 Recloser Assures Best Continuity of Service!

This rugged mechanical timer masterminds the General Electric FR-1 Automatic Recloser. Operating in air, its time-current characteristics remain exactly as published regardless of temperature, or viscosity changes of oil. You are assured of positive coordination—with breakers, reclosers in series, and with fuses.

Don't Lose Minutes of Protection While a Recloser Resets!

The FR-1 resets in a matter of seconds—instead of minutes—avoiding unnecessary fuse blowing and recloser lockouts from rapidly recurring faults. It holds service trips to a minimum during lightning and windstorms.

Picking Up the Load Is Easy!

With conventional operating function, manual reclosure is on time-delay. Furthermore, only G-E. includes the alternate "hold-closed" function—inrush currents can't lockout the recloser because it holds closed until these currents have subsided, then automatically resets for normal operation. This exclusive function also permits the use of more sectionalizing points and enables a saving in system investment.

Interrupting Ratings Are Realistic at Full Voltage!

The FR-1 performs smoothly at voltages from 2400 to 15,000. It is capable of clearing its maximum interrupting rating even at full voltage—your assurance of greater reliability.

No Problem with Load Growth!

No need to worry about load growth damaging the recloser. The FR-1 is self-protecting on overloads—withstands continuous current up to its minimum pickup rating—a feature which gives you time to plan system changes.

No Other Recloser combines these essential features. In addition the FR-1 gives you: choice of two operating functions—oil-blast interrupter—relay control of interrupter circuit—bushings interchangeable with those of modern G-E transformer—Thyrite protection for coils—conversion of ratings in service.

For a full story on this recloser including coordination data, write for bulletin GEA-4934. Address your nearest G-E Apparatus Sales Office or *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

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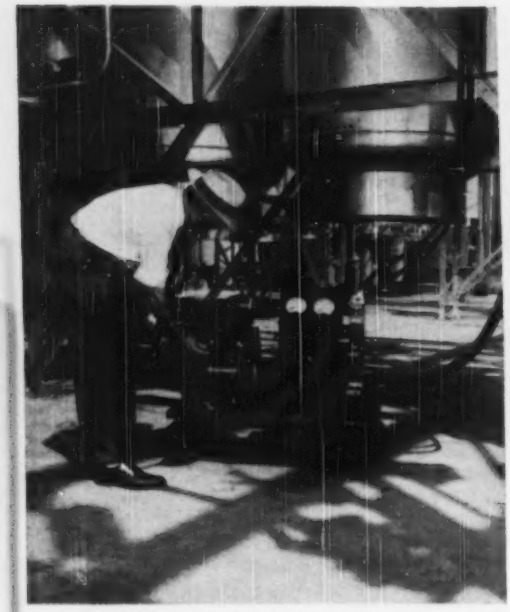
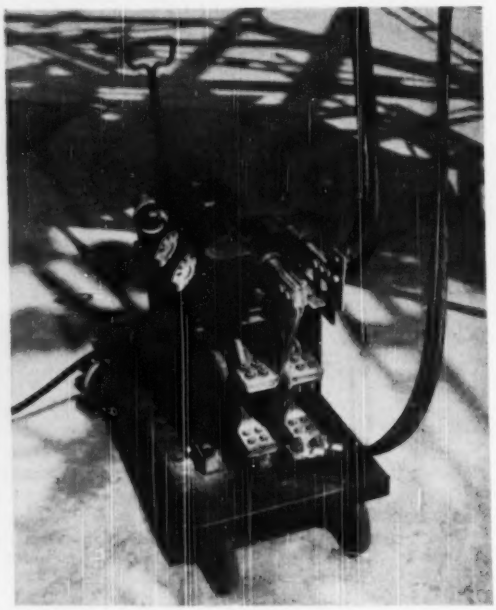
HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN



PORTABILITY AND SIMPLICITY are provided by this high current test set built and used by Portland (Ore.) General Electric Co



BUS ARRANGEMENT permits easy connection of test leads; instrument glass is protected by hinged cover, here shown partly open

High Current Test Set Is Easy to Move and Operate

DELMAR L. BROWN
Supt, Testing Dept
Portland General Electric Co
Portland, Ore.

For a high current test set which is readily portable and easily set up in the field, Portland General Electric has mounted its standard commercial test transformer equipment on a rubber-tired cart and installed permanent equipment for current measurement.

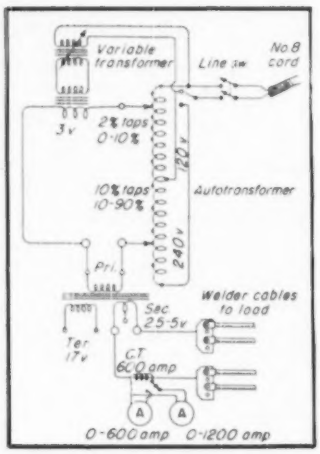
For field tests of circuit breakers, switch contacts, and current transformers, this portable unit contains manually regulated transformers capable of supplying accurately adjusted currents up to 3,000 amp. Supply current at 120 or 240 v is carried to the test unit with No. 8 flexible service cord. Secondary current to the device under test is carried in multiple paralleled welder cables made up with permanent silvered terminal lugs.

For test currents up to 1,200 amp, metering is provided by built-in apparatus consisting of a single 600-amp current transformer, with alternative switching to 600 or 1,200 amp, long scale switchboard type meters.

Wide Range, Accurate Control

This wide range of accurately controlled currents from a portable current test set is obtained by using the arrangement of conventional equipment shown at the right.

Although testing current available is limited by low secondary terminal voltage when the test circuit has much impedance, the unit has generally proven very convenient for many classes of testing.



CONVENTIONAL EQUIPMENT provides wide range of currents from a portable test set

This is General Electric's new secondary capacitor—3-kvar, 240-volts, single-phase—for pole mounting. It is approximately 40 per cent lower in price per kvar than similarly rated secondary capacitors heretofore available.

NOW! low-cost secondary capacitor

opens new fields in kvar generation

Secondary capacitors give the same benefits as primary capacitors for all the system, back to the generators, and in addition they decrease the voltage drop in the transformers and the secondary runs. Secondary capacitors will allow you to have more customers on each feeder, or existing customers can increase their load by 20 to 50 per cent for the same allowable voltage limits between the first and last customer with existing transformers.

Look into this new secondary capacitor for those load areas where either voltage drop or distribution transformer capacity is a problem. In many cases, it has proved most economical. We'd like to go over our calculations with you. Apparatus Dept., General Electric Co., Schenectady 5, N. Y. *Get in touch with your G-E representative, or write direct to Capacitor Sales Divisions, General Electric Co., Pittsfield, Mass.*

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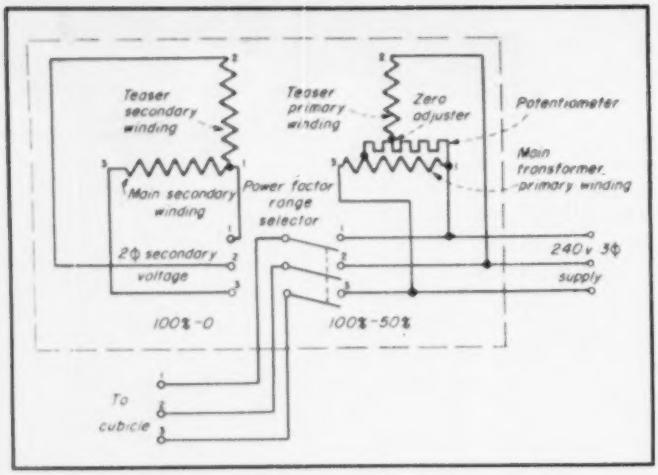

ONE-THIRD THE TIME of conventional methods is required to calibrate three-phase watthour meters using this zero power factor attachment on a standard testing board

Zero Power Factor Attachment Speeds Meter Testing

R. E. CROSBY
Meter Foreman
Washington Water Power Co
Spokane

ADJUSTING three-phase watthour meters at zero power factor with magnets removed can be done in 20 min compared to one to four hours required to do it with magnets in place. This is because rebuilt 3-ph meters are frequently so badly out of calibration that changes in one adjustment will affect all other adjustments, requiring a long and tedious sequence of adjustments using conventional test methods.

To test rebuilt meters at zero power factor with magnets removed, Washington Water Power Co has incorporated a zero power factor attachment in a standard watthour meter testing board. The attachment is made of a main and a teaser transformer in a T connection (see diagram).

A potentiometer is connected from 1-ph connection to a tap near the mid point of the primary of the main transformer. Primary of the teaser is connected from the phase not used by the main transformer to the variable contact on the potentiometer. Secondaries of the transformers are connected at a common point giving a 2-ph voltage with variable angle between phases controlled by the potentiometer.

With the power factor range selector on the attachment in the 100%-50% position, the phase shifter is bypassed and the 50% position of the power factor selector switch on the main panel provides a 50% power factor. With the power factor range selector on the attachment in the 100%-0% position, the 50% position provides zero power factor. For the zero power factor test, the phase shift zero adjuster controlling the potentiometer on the attachment is moved until the rotating standard stops, indicating zero power factor.

The 100% position of the power factor selector switch on the main panel furnishes unity power factor for both settings of the power factor range selector on the attachment. The phase shift zero adjuster has no effect on unity power factor setting.

Test Procedure

To adjust a 3-ph meter, the magnets are removed and the elements bucking each other at full load and unity power factor are adjusted to make the disk stand still. Next, each element of the meter is adjusted separately at zero power factor and full rated current until the disk stands still. Finally, with first one then another potential coil energized and with no load current, light load is adjusted for a slight tendency for the disk to turn forward. It is desirable in making these checks to turn the disk 180 deg and repeat the adjustment on the opposite side of the disk to correct for magnetizing effects in the disk. Creep holes must be kept out of the influence of the electromagnets.

The meter is adjusted for 100% load at unity power factor after the magnets are replaced. The adjustments described will leave it nicely balanced and very close to perfect adjustment at light load and 50% power factor.

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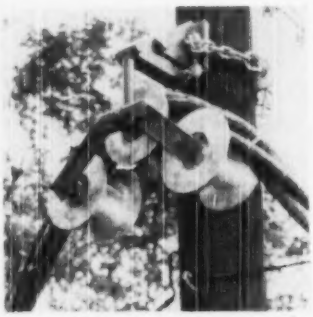


TRIPLE-SHEAVE running block swings out to carry 15-kv SS cable around 90-deg bends. Contact with the two lower, outside sheaves limits angle to which the cable can be bent

Triple-Sheave Running Block for Aerial Cable

A. C. FORT
and
J. V. CARVER
Jersey Central Power & Light Co
Morristown, N. J.

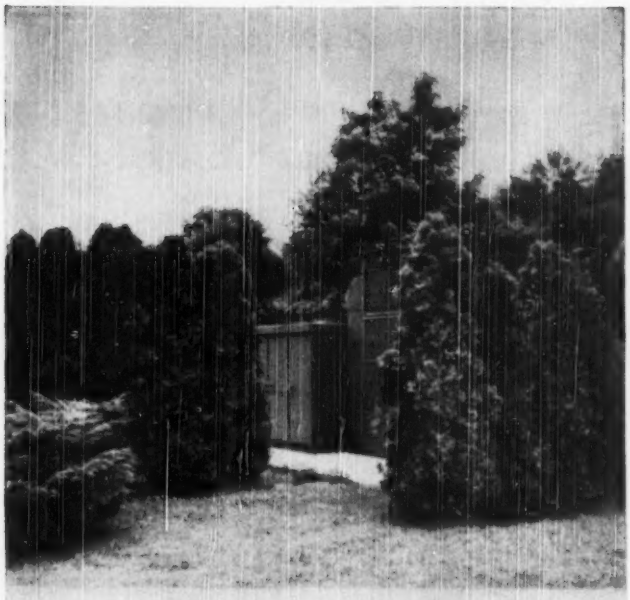
A NEW light-weight, triple-sheave running block, for use in pulling 15-kv SS cable, has been designed for and used by Jersey Central Power & Light Co. This new-type block offers a number of advantages:

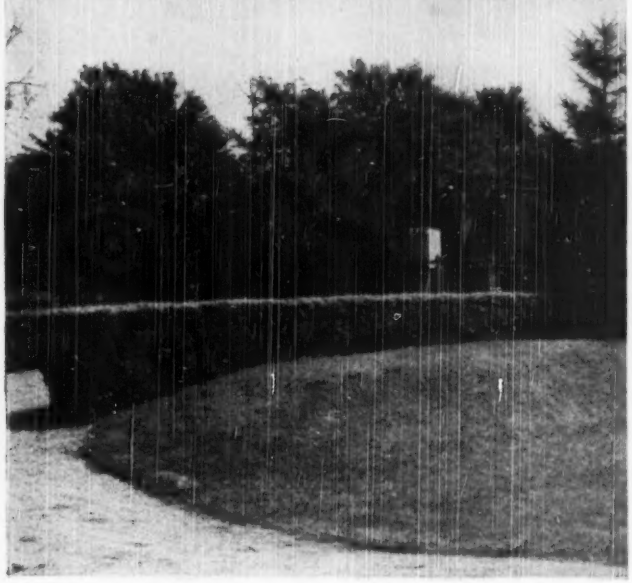
1. The chain-clamp decreases block mounting and dismounting time.

2. Hinged mounting of the running block permits turning sharper line angles up to 90 deg.

3. Damage to the cable by excessive bending is prevented by the three-sheave arrangement.

4. Wide sheaves allow the cable





THE PROBLEM OF
SUBSTATION APPEARANCE
IN RESIDENTIAL AREAS IS
EASILY OVERCOME WHEN YOU
INSTALL GENERAL ELECTRIC
UNIT SUBSTATIONS . . . .
THEIR INTEGRATED DESIGN
MAKES THEM EASY TO LANDSCAPE
AND THUS OVERCOME
APPEARANCE OBJECTIONS.
ASK YOUR G-E REPRESENTATIVE
FOR BROCHURE GEA-5155
THAT SHOWS HOW OTHER
UTILITIES TOOK ADVANTAGE OF
G-E ENGINEERING AND SERVICE
(TWO EXAMPLES AT LEFT).
OR WRITE TO . . . .
APPARATUS DEPARTMENT
GENERAL ELECTRIC COMPANY
SCHENECTADY 5, NEW YORK.

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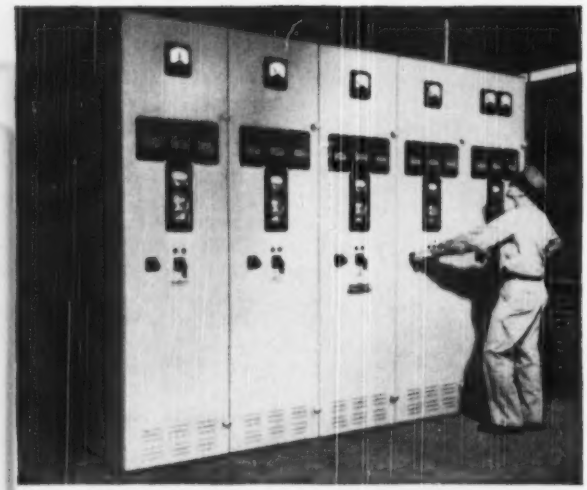
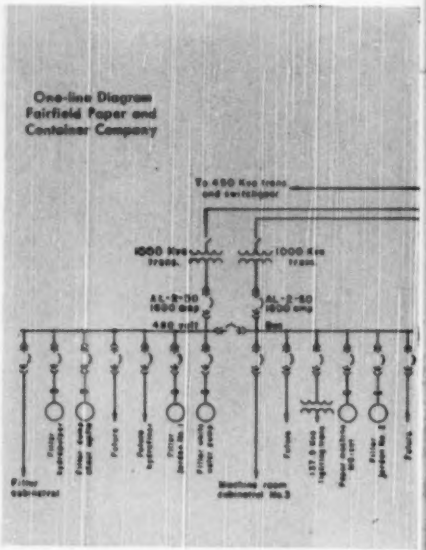
FAIRFIELD
PAPER AND CONTAINER CO. chooses a

METAL-CLAD
for



General Electric 5-kv Type MI-6 metal-clad switchgear consisting of one incoming-line breaker and four feeder breakers to handle 4160 volts at Fairfield Paper and Container Co. Magne-blast air circuit breakers are rated 1200 amperes, 100,000 kva interrupting rating. Note neat appearance of metal-clad unit. It's space saving too, and the metal-clad construction offers operating safety to personnel. Units like this are easily installed and can be added to with a minimum of bother and expense. Instruments and relays are co-ordinated for positive protection of circuits.



G-E Cabinetrol units provide centralized control for the liner stock system. Unit controls motors, valves, agitators, etc. Ammeters record load carried by hydrapulper and hydrofiner. Four other Cabinetrol units are used throughout the mill.

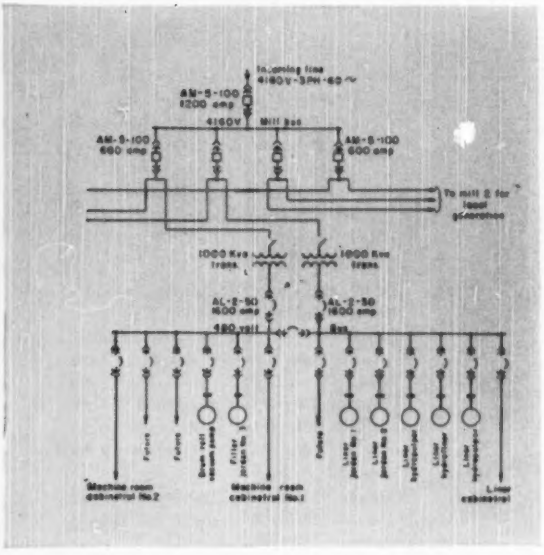
The Fairfield installation is a complete General Electric project—one source of responsibility plus the very best in co-ordinated planning, engineering, manufacturing, and servicing facilities to give maximum savings and efficiency to the customer.

Two G-E low-voltage metal-enclosed switchgear equipments take the 480-volt power from the 1000-kva transformers and distribute it to motors, lighting transformers, and five Cabinetrol units. The Type AL-2 transformer secondary breakers and tie breakers are rated 1600 amperes, 50,000 amperes interrupting rating. Type AK-1 drawout air circuit breakers of 25,000 ampere interrupting rating are used to feed motors and Cabinetrol. Breakers for future circuits can be installed in spare compartments. G-E air circuit breakers have adequate "IC" (Interrupting Capacity) for short circuit protection, are easily removed for inspection.

secondary-selective system using

SWITCHGEAR

continuity of service



At the new Fairfield Paper and Container Co. installation General Electric metal-clad switchgear receives the incoming 4160-volt power and distributes it to 4-1000 kva transformers for step-down to 480 volts. G-E metal-enclosed switchgear handles the 480-volt power through air circuit breakers of the drawout type. In general, all motors rated 60 hp and above are served by an individual breaker. Five Cabinetrol units are fed by air circuit breakers. Note that costly secondary feeders are short.

This secondary-selective system is only slightly higher in cost than a simple radial system, and provides Fairfield insurance against a complete shutdown in case of failure of any one transformer or its primary feeder cable. If trouble occurs the normally-open tie breaker is closed, thus providing an alternate source of power which permits the mill to operate at slightly reduced capacity.

Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

here's why...

"When we planned our new facilities it was decided that a secondary-selective power distribution system would assure us of the continuous power, even in case of a major fault, needed for continuous-process operations like ours. We ordered G-E switchgear because their "metal-clad" protection safeguarded our employees, and because we could get all engineering, equipment and service from one organization. By dealing with one company we saved considerable time and money. The units arrived complete and we installed them in very little time."

H. L. CUSTER, VICE PRESIDENT AND GENERAL MANAGER, THE FAIRFIELD PAPER AND CONTAINER CO., BALTIMORE, OHIO

MODERN INDUSTRIAL **power distribution systems using G-E switchgear are applicable to any industrial plant or commercial building where you want proper voltage for top performance of equipment, an extremely flexible setup to take care of expanding or changing loads, adequate short circuit protection, safety to personnel, and low installation and maintenance costs. A complete system, using G-E switchgear, costs you less than a "piece-meal," makeshift affair.**

INVESTIGATE TODAY **the many advantages of using General Electric switchgear in *your* plant for efficient, flexible power distribution. Contact your G-E sales representative for further information—or write for the helpful bulletins listed below.** ***Apparatus Department, General Electric Co., Schenectady 5, New York.***

GEA-3083	Metal-clad Switchgear
GEA-4966	Low-voltage Metal-enclosed Switchgear
GEA-3592	Load-center Unit Substations
GEA-3758	Load-center Power Distribution
GEA-4057	Interlocked-armor Cable for Primary Circuits
GEA-4352	Flamenol Cable for Secondary Circuits

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to run freely with a minimum of twisting.

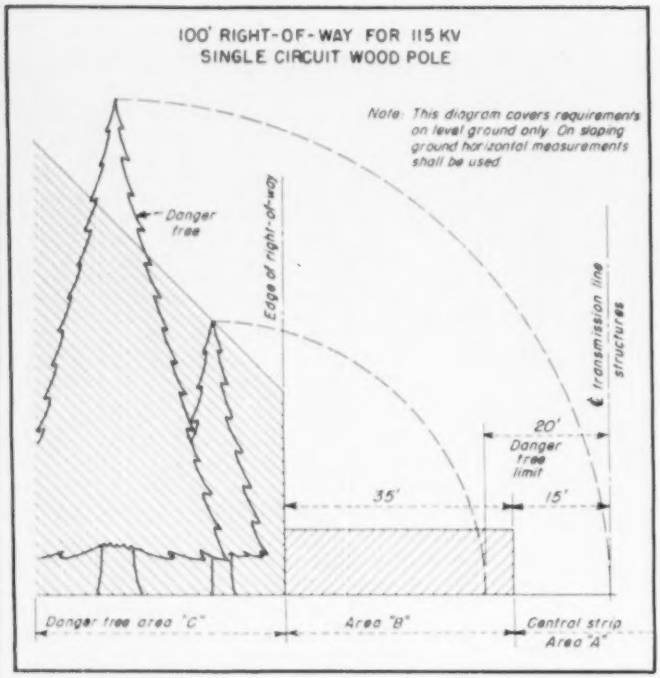
Sheaves of older type running blocks proved too small for the weight and diameter (3.691 in.) of the cable, particularly in pulling corners (ELECTRICAL WORLD, Aug 13, 1949, p 81). Because the hinged support of the new design allows the sheaves and their support to swing free with the cable, weight and tension are always in the bottom of the sheaves to prevent the cable from creeping up the sheave sides.

From the triangular hinged support is hung the running block on which are mounted three aluminum sheaves. When the running block swings out to carry the cable around a sharp corner, the angle to which the cable can be bent is limited by the two lower and outside sheaves of the trio to prevent cable damage.

A chain-clamp is used for attaching the alloy steel bracket and support to a pole. Estimated maximum working load of the 30-lb device is 2,200 lb.

The running block was designed, by Tug-O-Wheel Hand Plow Co.

• • •



INCREASING COSTS were the incentive for these revised clearing specifications of the Bonneville Power Administration. Instead of clearing entire width of right-of-way, brush and stumps under 10 ft are allowed to remain outside the center strip

Clearing Specifications Revised for Lower Costs

A. A. OSIPOVICH
and
R. J. MATHER
Bonneville Power Administration
Portland, Ore.

SPECIFICATIONS for clearing right-of-way have been revised, by Bonneville Power Administration, in an attempt to decrease clearing costs. The new specifications result in a right-of-way whose cross-section is a clear path along the central strip, with brush and stumps up to a height of 10 ft extending from the edges of the central strip to the borders of the right-of-way (see sketch).

Previous specifications required that the full width of the right-of-way be cleared of all standing timber, brush and forest debris found on the ground. Danger trees, defined as any tree that would come within a certain distance of the center line were it to fall directly toward the line, also were to be cut. These specifications produced a right-of-way which throughout its width contained only stumps and small ground cover.

Revisions

With costs steadily increasing during the post-war period, bids for clearing contracts, under this specification, became so high as to affect overall economy of line construction. In an attempt to decrease the cost of clearing without impairing safety of operation, the specifications were revised (see drawing) to require:

1. All trees throughout the width of the right-of-way be felled.

2. On a central strip slightly wider than the widest structure (Area "A" in drawing) all snags and stumps be cut to a maximum of 8 ft, all brush be cut to a maximum height of 2 ft and all forest debris be removed.

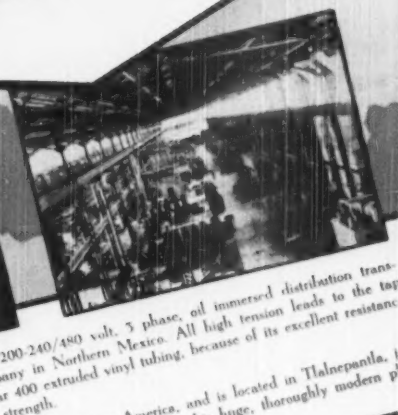
3. Outside the central strip all brush (Area "B") snags and stumps greater than 10 ft in height, be cut to a maximum height of 8 ft and all debris on the ground outside the central strip be allowed to remain, unless disturbed by the contractor's operations.

4. Danger trees which would come within a certain distance (Area C) of the centerline to be cut.

Another practice, aimed at decreasing costs of clearing, was to encourage land owners to remove merchantable timber prior to the entry of the clearing contractor. The contractor then had only to clean up the right-of-way. Naturally, location of lines to eliminate clearing is most effective.

Since revision of the specification, clearing costs have decreased, although it is difficult to determine to what extent these costs have also been influenced by such variables as labor supply, conditions in the lumber market, and the increasing number of bidders for the work.

NATVAR *in* MEXICO



Core-and-coil assemblies for three 45 kva, 13200-240/480 volt, 3 phase, oil immersed distribution transformers built by IEM for an industrial company in Northern Mexico. All high tension leads to the tap switch are insulated and protected with Natvar 400 extruded vinyl tubing, because of its excellent resistance to both heat and oil, and its good dielectric strength.

This is the largest electrical manufacturing company in Latin America, and is located in Tlalnepantla, just north of Mexico City. This interior view of one of the center bays of this huge, thoroughly modern plant shows the Tank Shop where core-and-coil assemblies are housed.

Industria Electrica de Mexico, S.A., (IEM) produces motors, transformers, switchgear and household appliances in accordance with designs and specifications of Westinghouse Electric Corporation. Natvar 400 Extruded Vinyl Tubing is used for all applications requiring a combination of good dielectric strength, with high resistance to both heat and oil. This tubing and all Natvar products are supplied in the Republic of Mexico through our agent, Jules Mattarelli, Paseo de la Reforma #137, Mexico, D.F. Telephone: 14-02-13.

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It's got EVERYTHING!

New Federal Noark Front-Operated Safety Switch

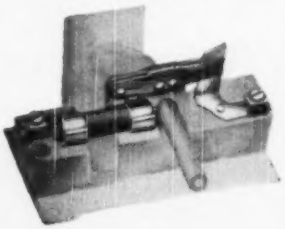
HERE IT IS—*exactly what you've wanted!* The new Federal Noark Front-Operated Safety Switch is absolutely without equal . . . safest . . . easiest to install and maintain . . . coolest in operation. It brings completely new standards of service life and economy.

This new switch is safest because of its unique guaranteed current break, its visible blade construction, and special 3-position, front-operated handle. Arc mufflers or Rolarc snuffers extinguish arcs instantly . . . accommodation for four locks makes cover virtually tamper-proof.

Maintenance is easiest because the new Noark design permits removal of blade and mufflers in a jiffy. Entire switch mechanism is removable from enclosure. Unit pole construction (each pole on an individual block) cuts losses due to accidental breakage.

Loose joints cause heat: to assure coolest operation, this new switch has only *two* joints to each pole (some switches have as many as seven). These joints are held under extreme tension by powerful steel springs. An ingenious one-piece fuse terminal and lug construction, and a new patented high pressure fuse holder are further assurance of low operating temperatures and long service life.

New Federal Noark Front-Operated Safety Switches come in 30, 60 and 100 ampere capacities, for 230-volt A. C. –250-volt D. C. and 575-volt A. C.–600-volt D. C. Type "C" Front-Operated Safety Switches, available in the same sizes, have many of these special features. Start at once to secure the outstanding advantages of these remarkable switches. Order them from your distributor. And mail coupon on next page for full, detailed information.

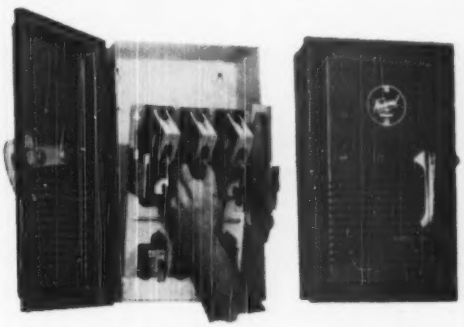


1 For coolest operation, the new Noark Safety Switch has only two joints to each pole and they are both under high tension. Heavy external steel springs along the switch blade apply constant pressure at both hinge and breakjaw.

2 Pressure spring of the patented fuse holder is located in block under fuse where unaffected by heat. High-pressure lever action assures minimum contact resistance: cool operation. No screws to work loose; no springs near fuse to become annealed.

3 This is the only visible blade switch with the operating cross bar *beneath* the switch blades. The operator is thus safeguarded because the cross bar forces open the contacting blades regardless of broken hooks or damaged hinge mechanism.

4 New Federal Noark Front-Operated Safety Switches of more than 250 volts are protected by Noark Rolarc Snuffers. These operate by means of two arc-resistant rollers which snap together when switchblades leave the breakjaw and extinguish arcs instantly.



5 Entire switch mechanism is mounted on a back plate which can be removed from the box by loosening three self-retaining screws. Wiring is quick and easy. Blades and mufflers can be removed in a few seconds. Individual pole blocks cut losses due to accidental breakage. As these new Safety Switches are operated from the front, they can be closely banked for maximum space saving.

6 Federal Electric has spared no expense in making the new Noark Front-Operated Safety Switch smart and attractive in appearance as well as mechanically perfect. Enclosures are of code grade steel, finished with gray baked enamel . . . Each switch carries Underwriters' Laboratories approval and has the maximum horsepower rating for its size allowed by the Underwriters.

Federal Electric Products Company
50 Paris St., Newark 5, N. J.

Gentlemen: Please send us by return mail complete printed information about the new Federal Noark Front-Operated Safety Switch.

My name .....

Company name .....

Address .....

City ..... State .....

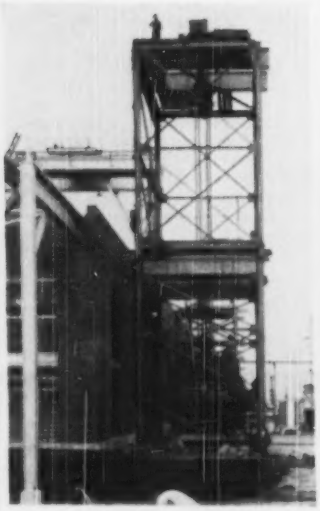
My distributor is .....

FEDERAL NOARK

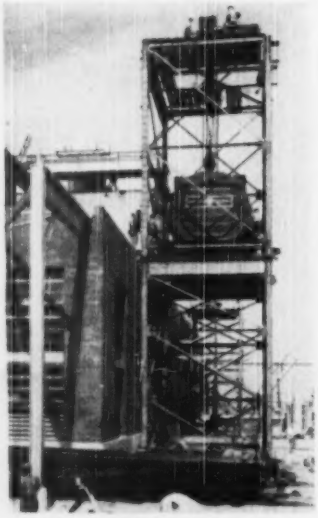
FRONT-OPERATED SAFETY SWITCH

Complete line of Federal Electric Products includes Motor Controls, Safety Switches, Service Equipment, Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct ★ Sales offices in principal cities.

Elevator Places Generator on Foundation In Basementless Building



1 ELEVATOR ready to raise a 140-ton stator skidded from flatcar in foreground into bottom of tower. Braces on lower section of tower were removed while stator was being skidded and then were replaced



2 TWO ELECTRIC HOISTS on top of tower raised stator 30 ft above ground floor level of station. Workmen unbolt upper section of tower from lower section. Building houses condenser and other auxiliaries

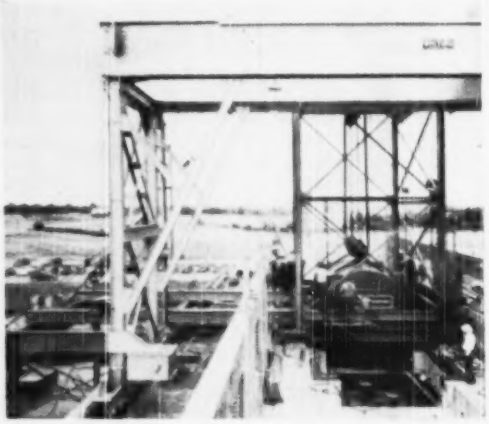
Steel hoisting tower is used to move turbine-generator stators to top of turbine-generator foundation. Tower is constructed of two 31-ft high sections bolted together and can be dismantled into a compact unit for shipping. It is scheduled for similar jobs at eight power plants

•

TOWER DESIGN is by W. M. Wolford of Ebasco Services Inc. who directed construction of the Cecil Lynch steam-electric station of Arkansas Power & Light Co at Little Rock.

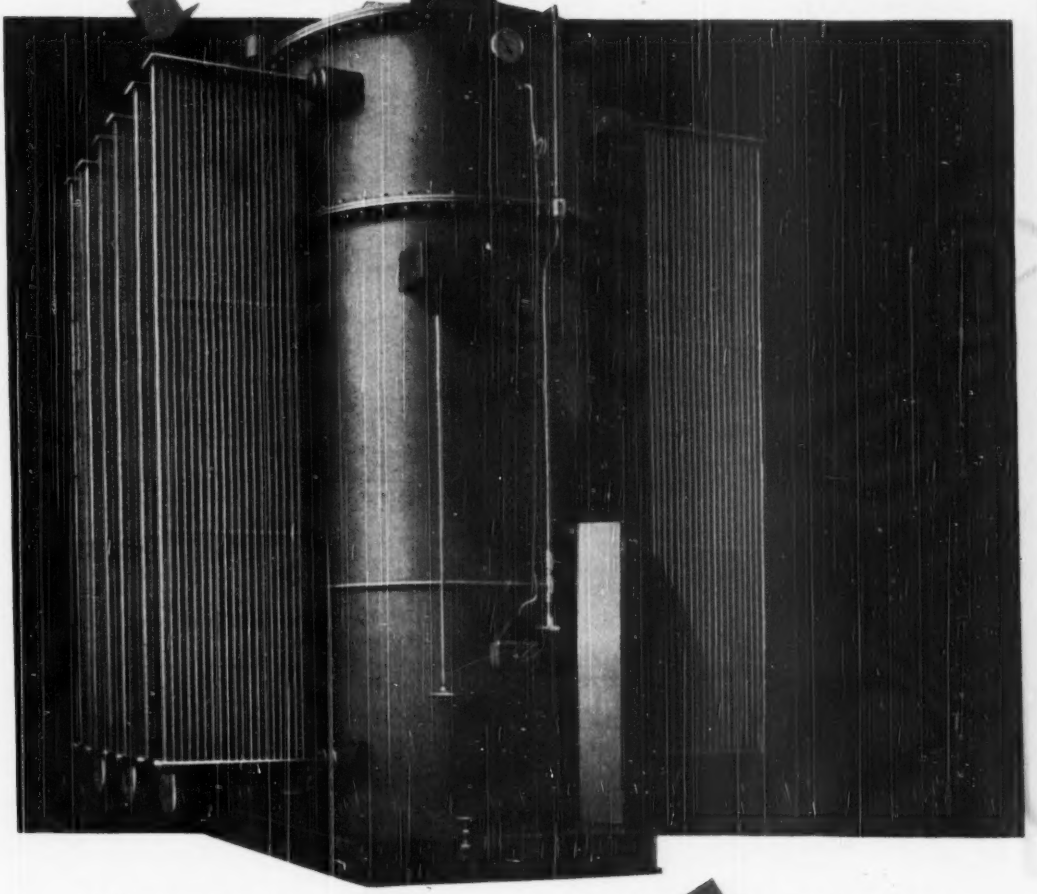
Illustrations show how a 140-ton stator of a 66,000 kw generator was placed in 6 hr at the Cecil Lynch station. Regular station crane was used to erect all of turbine-generator, except stator; other largest part weighed only 30 tons.

3 ON OPERATING or "second" floor level upper section of hoisting tower is ready to be skidded to turbine-generator foundation at right end of I-beam tracks. Condenser fits inside of turbine-generator foundation. Gantry crane used to pull tower along tracks



4 STATOR is lowered onto turbine-generator foundation by hoists on tower. After stator was placed, tower top was moved back to original position and entire tower was dismantled for shipment to another generating station for use in similar work

What goes into MOLONEY TRANSFORMERS comes back to YOU in profits



It is the quality of materials that go into a tranformer . . . plus the skill of the engineers and craftsmen who design and fabricate it . . . that determines transformer performance. Moloney's completely equipped laboratory constantly tests raw materials. Adherence to rigid specifications ensures the use of materials of the highest quality. These factors plus a factory organization with years of experience in exclusive transformer manufacture are your guarantee of better profits through better transformer performance.

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TRANSFORMERS EXCLUSIVELY SINCE 1896

SAINT LOUIS 20, MISSOURI

. . . OVER 50 YEARS OF LEADERSHIP IN DESIGN, RESEARCH, ENGINEERING

Transformer Fuse Schedule

Tables adapted from construction methods of Pacific Power and Light Co, Portland, Oregon

Fusing for Transformer Banks Composed of Units of Unequal Kva Rating

Open-Delta or Open-Wye Connected Banks:

Fuse each transformer according to its size. In case of open delta with one lead common to two transformers, fuse this lead according to rating of larger transformer.

Delta-Delta Connected Banks:

Fuse both phase connections to largest transformer according to single-phase column; fuse other phase connection common to other two transformers in accordance with size of larger of these two using three-phase delta-delta column. If fuse size so determined is larger than other fuses, fuse all phase connections with larger fuse size.

Secondary Fusing for Single-Phase Installations Only (Note 1)

Kva	Secondary	Size of Type N Replaceable Link
1, 1.5, or 2	120v or 120/240v	50 Amp
2.5 or 3	120/240v	75 Amp
5, 7.5	120/240v	100 Amp
		Non-Replaceable Link
10, 15	120/240v	200 Amp
20, 25	120/240v	300 Amp

NOTE

1. Number in parenthesis, e.g. (1), indicates the rating of a link with high surge characteristics which is preferable if available. Secondary fusing is not to be used with this link.

TABLE I—Fuse Sizes for 2400-v and 7200-v Single-Phase Transformers

Kva Rating of each Single-Ph Transformer	2400-v System and 2400/4000-v System Using 2400-v Transformers				7200-v System and 7200/12000-v System Using 7200-v Transformers			
	Single-Phase Conn Three-Phase Conn 4 Kv Wye-Delta, 2.4 Kv Open-Delta, 4 Kv Open-Wye		2.4 Kv Three-Phase Conn Delta-Delta		Single-Phase Conn Three-Phase Conn 12 Kv Wye-Delta, 7.2 Kv Open-Delta, 12 Kv Open-Wye		7.2 Kv Three-Phase Conn Delta-Delta	
	Rated Amp	Fuse Rating	Line Amp	Fuse Rating	Rated Amp	Fuse Rating	Line Amp	Fuse Rating
		(Note 1)				(Note 1)		(Note 1)
1	0.4	5*(2)			0.14	5*(1)		
1.5	0.6	5(2)	Use Open Delta		0.21	5*(1)		
2	0.8	5(3)			0.28	5*(1)	Use Open Delta	
2.5	1.0	5(3)			0.35	5*(1)		
3	1.2	5(3)	2.2	8	0.42	5*(2)		
4	1.7	5	2.9	8	0.56	5*(2)		
5	2.1	8	3.6	15	0.69	5*(2)	1.2	5(3)
7.5	3.1	8	5.4	25	1.04	5**(3)	1.8	5
10	4.2	15	7.2	25	1.39	5**(3)	2.4	10
15	6.2	15	10.8	25	2.08	5	3.61	15
20	8.3	25	14.4	50	2.78	8	4.8	15
25	10.4	25	18.0	50	3.47	8	6.0	25
30	12.5	40	21.6	75	4.17	15	7.22	25
37.5	15.6	40	27.0	75	5.21	15	9.01	25
40	16.7	50	28.8	75	5.56	15	9.62	40
50	20.8	50	36.0	100	6.95	25	12.0	40
75	31.2	75	54.0	150	10.4	25	18.0	50
100	41.7	100	72.0	200	13.9	40	24.1	75
150	62.5	150	108	200	20.8	50	36.0	100
200○	83.3		144		27.8		48.1	
250○	104		180		34.7		60.0	
300○	125		216		41.7		72.2	
333○	139		240		46.3		80.0	
400○	167		288		55.5		96.0	
500○	208		360		69.4		120	

TABLE II—Fuse Sizes for 12000-v and 23000-v Single Phase Transformers

Kva Rating of each Single-Ph Transformer	7200/12000-v System Using 12000-v Transformers				23000-v System Using 23000-v Transformers (200/100 to 1)			
	Single-Phase Conn Three-Phase Conn Open-Delta		Three-Phase Conn Delta-Delta		Single-Phase Conn Three-Phase Conn Open-Delta		Three-Phase Conn Delta-Delta	
	Rated Amp	Fuse Rating	Line Amp	Fuse Rating	Rated Amp	Fuse Rating	Line Amp	Fuse Rating
		(Note 1)		(Note 1)		(Note 1)		(Note 1)
2.5	0.20	5*(1)	Use Open Delta		0.22	5*(1)	Use Open Delta	
3	0.24	5*(1)			0.33	5*(1)		
4	0.32	5*(1)			0.44	5*(2)	0.75	5(2)
5	0.40	5*(2)	0.69	5(2)				
7.5	0.60	5*(2)	1.04	5(3)				
10	0.80	5**(3)	1.39	5				
15	1.20	5**(3)	2.08	8	0.65	5*(2)	1.13	5(3)
20	1.61	5	2.78	8	0.87	5**(3)	1.51	5
25	2.00	5	3.47	10	1.09	5**(3)	1.88	5
30	2.40	8	4.16	15	1.30	5	2.26	8
37.5	3.01	10	5.20	15	1.63	5	2.82	8
40	3.21	10	5.55	15	1.74	5	3.01	8
50	4.01	10	6.95	25	2.17	8	3.76	10
75	6.01	15	10.4	25	3.26	10	5.65	15
100	8.02	25	13.9	40	4.35	15	7.53	25
150	12.0	40	20.8	50	6.52	25	11.3	40
200○	16.0		27.7		8.7		15.0	
250○	20.0		34.7		10.9		18.8	
300○	24.1		41.6		13.0		22.6	
333○	26.7		46.3		14.5		25.1	
400○	32.1		55.5		17.4		30.1	
500○	40.1		69.4		21.7		37.6	

Footnotes for Tables I and II.

* Secondary fuses shall be used in addition to conventional primary fuses for single-phase installations.

** Secondary fuses shall be used in addition to conventional primary fuses where secondary and service is longer than 200 feet for single-phase installations.

○ Protection for transformers larger than 150 kva to be specified by general superintendent.

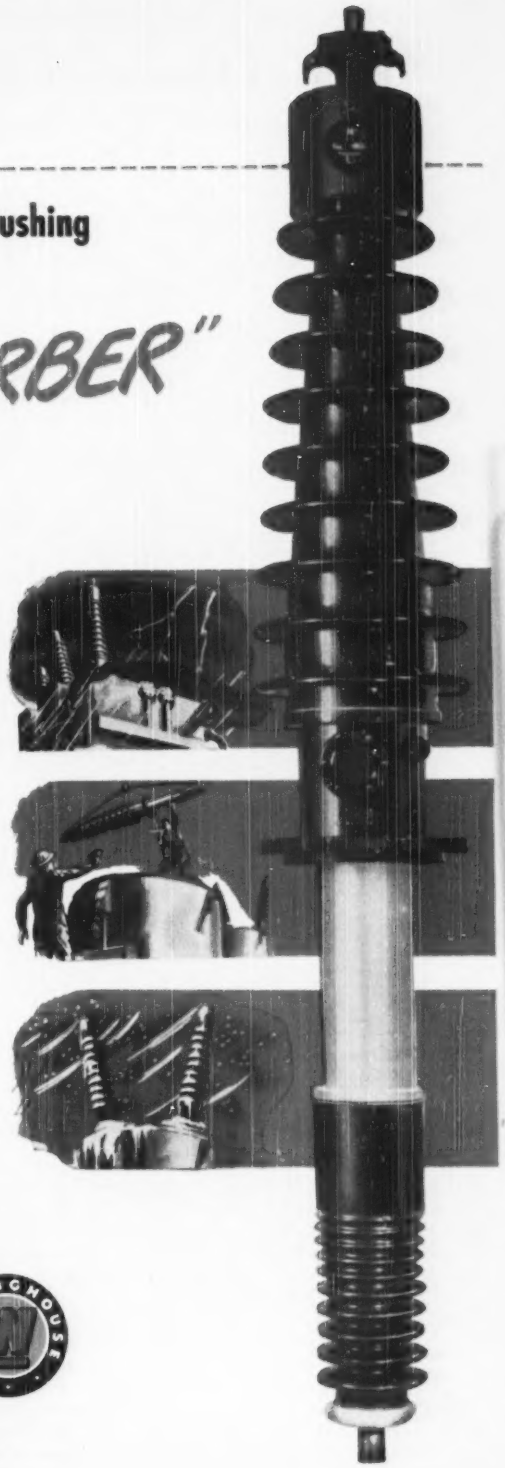
YOU CAN BE **SURE**.. IF IT'S

Westinghouse

Type "O" Condenser Bushing

3 WAY "SHOCK ABSORBER"

FOR POWER CIRCUIT BREAKERS AND POWER TRANSFORMERS



ELECTRICALLY . . . Insulation of the highest quality is provided in the condenser, which is completely impregnated with degassed oil, hermetically-sealed and cushioned with dry nitrogen to insure continued low internal loss and radio-influence voltage.

MECHANICALLY . . . Springs in the cap keep pressure on the gaskets at all times. The porcelains are one piece. Bushing construction is strong mechanically.

THERMALLY . . . Because of its excellent design—electrically and mechanically—the Type "O" Bushing is not affected by heat or cold. Internal losses do not increase appreciably over the temperature ranges encountered in transformers or circuit breakers.

Greater electrical, mechanical and thermal strength add up to increased safety for your system. All the facts on the Type "O" Bushing are available from your nearby Westinghouse representative. Ask him for Booklet B-3462, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. Also ask for information about circuit breakers and transformers equipped with Type "O" Bushings. J-60711

Westinghouse

POWER CIRCUIT BREAKERS

POWER TRANSFORMERS

Economical Measurement of Power Transformer Loads

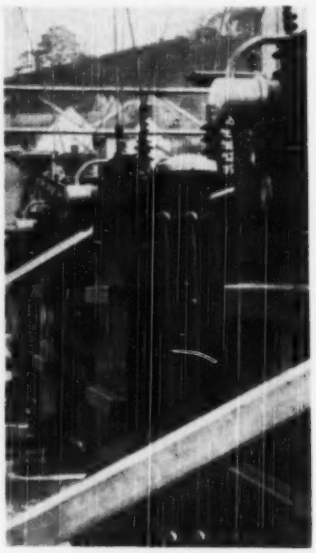
C. P. ZIMMERMAN
American Gas and Electric Service Corp
New York, N. Y.

A COMPARATIVELY inexpensive method of obtaining load data on distribution station transformers is now in general use by the operating companies of the American Gas and Electric System. It involves the use of thermal ammeters, mounted directly on the power transformers, in conjunction with multi-ratio bushing current transformers on the secondary bushings serving as permanent accessories.

Records obtained in this manner are used to forecast new transformer requirements and anticipate transformer changes or shifts. As a result, such changes can be better fitted into work schedules and budgets to bring about improved power transformer utilization.

All single-phase transformers above 500 kva having primary ratings of 22,000 v and up and secondary ratings of 15,000 v and below are supplied by the manufacturer with one bushing current transformer on the X-2 bushing. An indicating outdoor type of thermal ammeter with a 0-6 scale is mounted on each transformer, approximately six feet above its base, and connected to the appropriate tap of the BCT. The tap selected provides about full-scale reading for rated load.

These thermal ammeters have two pointers: One giving the present 30-min demand; the other giving the maximum 30-min peak since the last reading. Because of the low burden imposed on the BCT's, the accuracy of measurement is within 1 to 2%, considered sufficient for the purpose. Installation cost is small since only two to three feet of secondary wiring is necessary. For a bank of four single-phase transformers the total installed cost of the BCT's and ammeters is about $330.

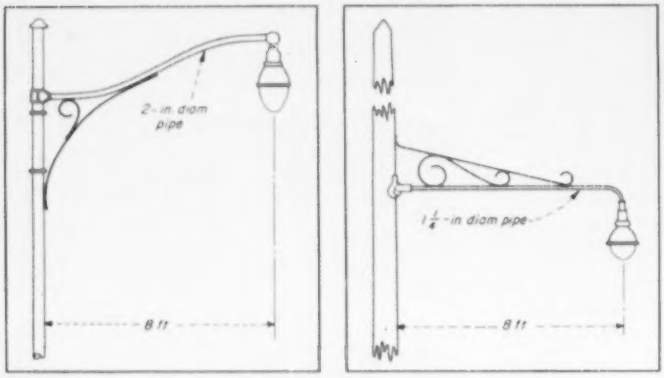


THERMAL AMMETERS, mounted about 6 ft from transformer base, indicate any present overloading and assist in planning for future loads at a 4,500-kva, 33/4-kv station

In the case of three-phase transformers, BCT's are obtained on each secondary line bushing and three thermal ammeters are mounted on the power transformer. Total installed cost is approximately $250.

A knowledge of the extent to which power transformers in the various distribution stations are loaded should more than justify the expense. Equipment damage and outages due to burned out transformers, with attendant customer ill-will, may be averted.

The reading cost is of no consequence, as the ammeters are read once a month by personnel visiting the stations for routine maintenance or inspection.



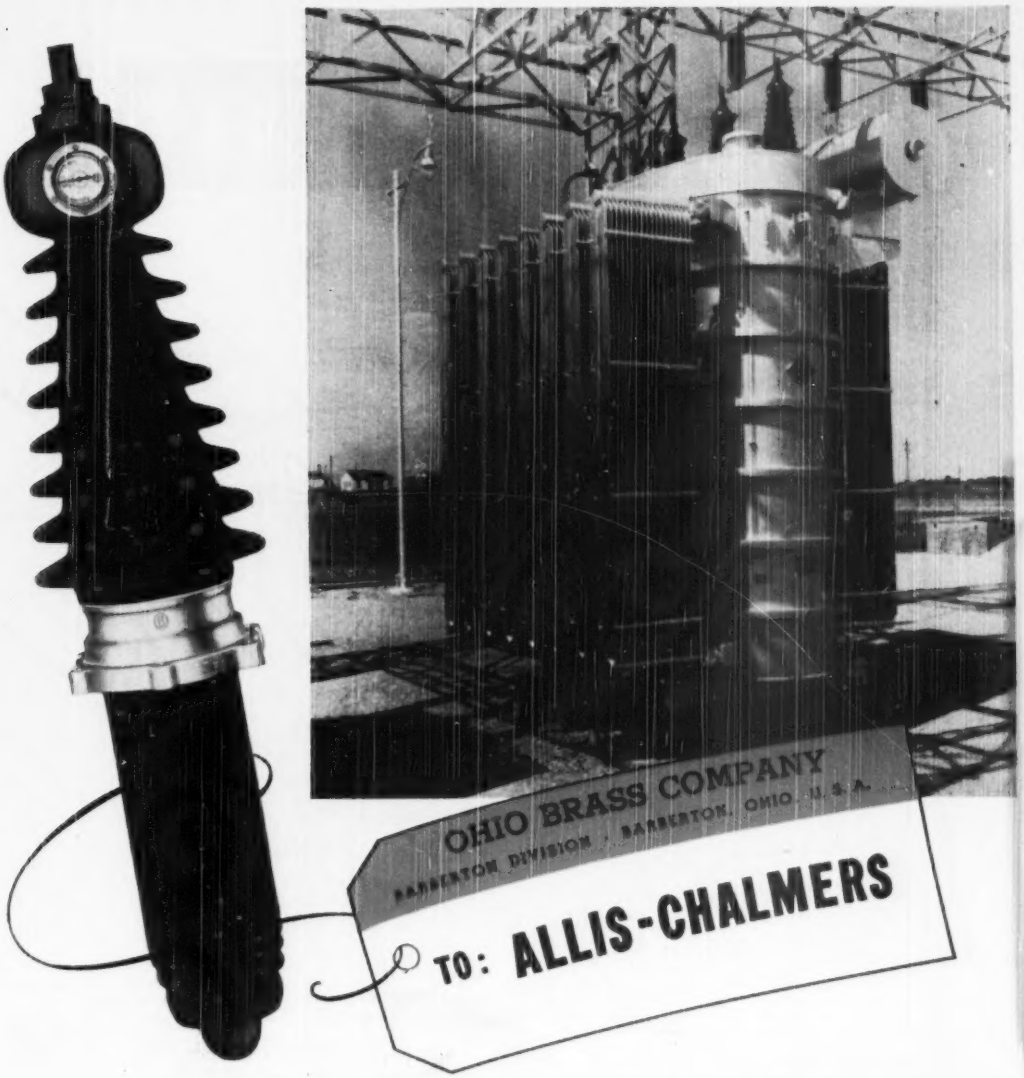
BRACKET forms and sizes for street-light supports on ornamental and wood poles

Aluminum Street-Light Brackets Cut Maintenance

THROUGH the installation of aluminum alloy brackets, maintenance of street-light supports has been reduced by an east coast utility. Ability of aluminum to withstand weather and atmospheric conditions and the gradual increase in the number of aluminum brackets on new lines are factors contributing to lower maintenance costs. In addition, aluminum brackets are easier to handle because their weight (15 lb) is about one-third that of the steel formerly used.

Over a period of 18 months, steel bracket replacements have been made on an average of 100 per month. About 400 brackets per month have been installed for new lights.

Use of aluminum eliminates corrosion and thus avoids a painting operation which requires the use of a small truck with an extension ladder and a crew of two.



When load growth called for the addition of a new substation in a Southern metropolitan area, this Allis-Chalmers power transformer was selected for the job. Rated 15,000 kva, and capable of 20,000 kva with cooling fans, Allis-Chalmers points out such features as: "simple, protective 'Oil-Sealed' inert gas system pioneered 26 years ago and now standard on over 5 000,000 kva of U. S. Power . . . rigidly braced and specially treated circular coils . . . controlled gasket compression . . . Bonderized radiators . . . . ."

ALSO (B) BUSHINGS

ONE OF THE FINEST COMPONENTS OF ANY TRANSFORMER

3001-H

Ohio Brass MANSFIELD, OHIO

There's POTENTIAL

ALCOA FIRST IN ALUMINUM

in RESEARCH, too

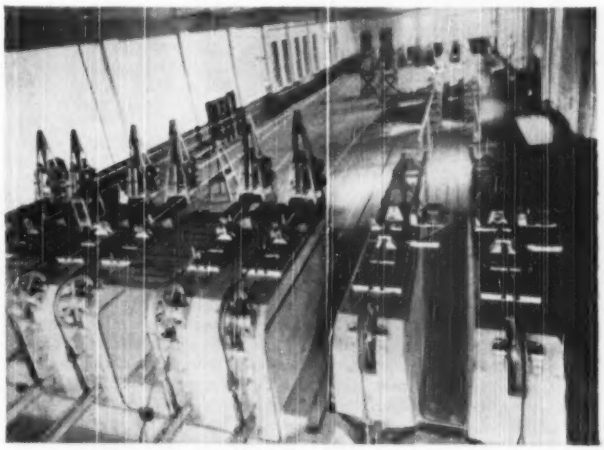
Alcoa's work on ACSR really just began when its scientists developed this conductor. They went on to work out simpler ways to engineer high lines; found ways to beat the strain of "long spans". Devised ways to throttle vibration and prevent fatigue. To bring you the best ACSR it's possible to make and the best installation methods known.

Sixty-two years of experience with aluminum and electricity constitute an important "potential"—ever-expanding ACSR know-how—that pays off in better service for you and your customers. ALUMINUM COMPANY OF AMERICA, 1924A Gulf Bldg., Pittsburgh 19, Pennsylvania.

★

TYPICAL: Here's what we mean by research: In Alcoa's Massena, N. Y., laboratory these machines give cables "the shakes" for as long as a year to determine their fatigue strength. Conductors meet a lifetime's trials within months. It adds up to better cable and improved installation methods for you.

★



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FOREMOST IN A·C·S·R

The man on the pole will tell you— KLEINS

Since 1857

If you know linemen, you know they want the finest in quality when it comes to equipment. Not only does their job depend on it—many times their lives do.

It is the reputation of nearly a century in designing and manufacturing the finest in linemen's equipment that has won Klein its position of preference with linemen and electricians everywhere.

It is easy to make equipment that looks like Kleins. It takes years of experience plus extensive manufacturing facilities to make equipment that performs like Kleins.

Today you are assured prompt delivery on all Klein products. Be sure your pliers, climber straps, safety belts and other items carry the Klein trade-mark—famous for quality "since 1857."

ASK YOUR SUPPLIER
Foreign Distributor:
International Standard Electric Corp., New York

The Klein Pocket Tool Guide showing the Klein line and containing useful tool information will be mailed on request.

Mathias KLEIN & Sons
Established 1857
Chicago, Ill., U.S.A.
1200 BELMONT AVENUE CHICAGO 1 ILLINOIS

GEAR LUBRICATOR, consisting of grease container, pipe with fitting to the container and compressed air jet connection, is light-weight and can be handled easily by one man

Jet Lubricator Makes Gear Greasing Easier

GEAR GREASING has been made easier at the Harding Street Plant of Indianapolis Power & Light Co by a jet greasing device developed by plant superintendent George Spangler. The device consists of a cylindrical grease container fitted with a pipe having a compressed air jet arrangement and connected to an air hose. A filler plug permits filling the cylinder with grease.

Grease used is a special commercially available combination of heavy gear lubricant and carbon tetrachloride. The carbon tetrachloride provides thinner necessary for application of grease in this manner, but evaporates quickly leaving the gears greased with proper lubricant.

The jet lubricator is a light-weight device and is very easily handled. Amount of grease applied is controlled by regulating the air jet. By holding the lubricator with the grease container on top, grease feeds down into the jet by gravity.

Gears are given better lubrication because they can be greased every eight hours instead of every two days as was provided by the previous schedule.

Burns Full-Seam Coal To Cut Costs

WEST PENN POWER CO, operating two 1,000,000 ton per year captive soft coal mines in the Pittsburgh area has adopted "full seam" mining practice. The practice resulted in an estimated saving of

Your Central Conduit Distributor

...READY AT YOUR BECK AND CALL

Your Central Conduit Distributor is *always* ready at your beck and call...even if it means personal inconvenience. He's built his business on prompt service. And he maintains balanced stocks of quality electrical supplies ...like Central Rigid Steel Conduit...famous for easy cutting, bending and threading.

Next time you need conduit or other electrical supplies, contact your Central Conduit Distributor. You'll like his friendly service.

SPANG-CHALFANT
Division of The National Supply Company
General Sales Office: Grant Building, Pittsburgh, Pa.
District Offices and Sales Representatives in Principal Cities

CENLACO a hot dipped galvanized and lacquered finish, inside and out.

CENTRAL WHITE electro-galvanized outside and black enameled inside.

CENTRAL BLACK permanent, baked-on black enamel finish, inside and out.

Polyken®

No. 163 Electrical Tape

8 ways better than "friction tape"

Get these "extras" for Better Performance!

- **Higher dielectric strength**
- **Better moisture barrier**
- **Less bulk—with equal strength**
- **Sticks quicker (higher "tack")**
- **Cleaner—doesn't collect grime**
- **Unwinds easily**
- **Doesn't fray**
- **Sticks firmly to any clean surface**

Wherever you use "friction tape," you'll get better, more dependable service from POLYKEN No. 163 electrical tape. For No. 163 tape is dielectrically stronger, less bulky, more moisture-resistant . . . cleaner, too, because its non-sticky backing won't pick up grime.

No. 163 is easy to handle. It unwinds easily, sticks quickly and firmly, and is non-fraying—yet it costs you no more than most ASTM friction tapes!

Let POLYKEN No. 163 go to work for you today! Your distributor can supply you with a handy introductory package containing six ¾ in. x 90 ft. rolls.

Polyken® INDUSTRIAL TAPE

DEPARTMENT OF BAUER & BLACK DIVISION OF THE KENDALL COMPANY

333 W. ADAMS ST., CHICAGO 6

10¢ per ton on the entire product.

Full seam mining, however, has the effect of increasing ash content of the coal from 10% to 15% since low grade "boney" coal that was formerly cut out of the seam is now mixed with the higher quality coal above and below it in the seam.

The company is also buying "boney" coal in 200-300 ton per day quantities from non-company mines that cut out boney and throw it away. The low price boney is mixed with higher quality coal to produce an economy fuel which, like the product of full seam mining, is burned in the newer-type boilers that can burn higher ash fuel.

Disadvantages

Two boiler tests at Springdale station have demonstrated that boilers there can burn low cost "boney" coal entirely and carry full load. However the burning of such high ash coal has several disadvantages:

1. Mill maintenance is high due to high ash content.
2. Additional pulverizing mill capacity is required.
3. High ash content may increase tube erosion.
4. Fires are dirtier and fly ash output is doubled.
5. Amount of ash to be handled is greater.
6. Slag accumulations form more rapidly, force more soot blowing.
7. Boiler efficiency is decreased.

The economy coal that results from mixture of boney with higher grade coals has shown savings compared with product of the company's own full-seam mining operations. The company estimates that the cost of economy coal is 80% of the cost of former coals even when transportation and handling costs are included.

Savings Achieved by New Uses For Old Tools

IN ADDITION to its use by Toledo Edison Co for street light pole work, a ladder truck is also used for the installation of potheads on distribution cables on lateral poles.

Another new use is made of a portable fibre duct trimmer which can be used for renewing the taper on random lengths of fibre duct. It does this work rapidly and accu-

rately. In the past renewing tapers on fibre duct was done by hand by the workmen.

Two small walkie-talkie type radios used by line department are smaller and more portable than walkie-talkie military radios. The user can contact company trucks and dispatchers in steel tower work, in pulling wire and cable and in communication work during the locating of faults in underground cable. These units have a range of about three miles in good weather.

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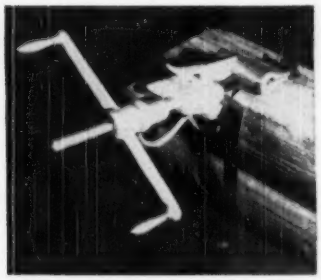


STEEL BANDING is installed in simple fashion with special tool. Small dogs on clamp (upper edge of crossarm) are bent to hold banding securely in place

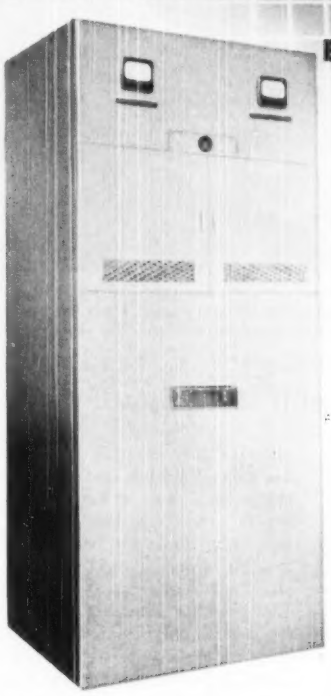
Steel Banding Is Versatile Tool

G. A. JERNIGAN
Supt, Distribution and Transmission
El Paso Electric Co

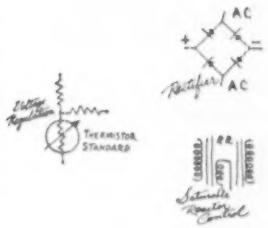
STAINLESS STEEL BANDING is being used with excellent results by El Paso Electric Co for such diverse jobs as repairing or reinforcing split crossarms or pole tops, attaching transite tubing to poles or crossarms and as a pipe fastening in underground construction. The repair or reinforcing of split poles or crossarms by this banding is much faster and more satisfactory in strength and appearance than are conventional methods.

The banding comes in 100-ft reels of various widths and is easily and quickly installed by use of a single special tool. After the band is measured to desired length, it is cut and tightened, the end bent to its final position and the excess cut off by the tool. Small dogs on the band clamp (see illustration) are bent over to hold the end firmly in position.

HIGHER EFFICIENCY
OVER WIDE LOAD RANGE WITH PECO
BATTERY CHARGERS



- New control circuits
- Reduced stand-by power consumption
- Accurately controlled



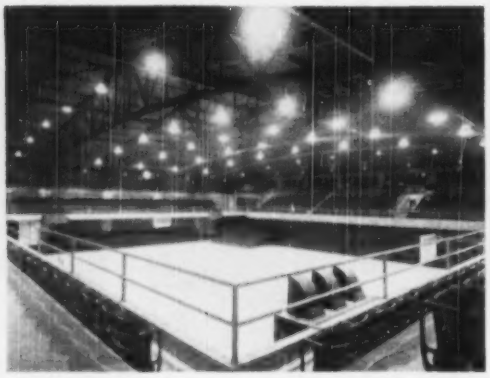
PECo Battery Chargers establish a new standard of efficiency in charging equipment . . . Incorporating the latest developments in selenium rectifier stacks, transformers and saturable reactors, power loss has been cut to a minimum. Convection cooled, there are no fans, blowers or other moving parts; thus maintenance is minimized, and stand-by power loss reduced to practically zero. Important, too, is the fact that this new higher efficiency has been achieved with *no sacrifice* of control accuracy . . . Look into a PECo Battery Charger; you will find an outstanding quality in both workmanship and material; you will find that every component is conservatively rated to give an extra guarantee of safety, efficiency and durability . . . Write today for complete information.

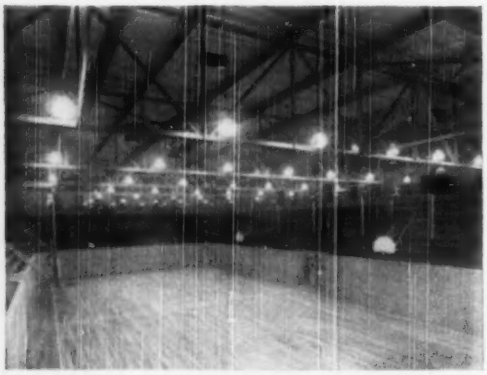
POWER EQUIPMENT Company

Specialists in Controlled Rectifiers Since 1935

55 ANTOINETTE STREET / DETROIT 2, MICHIGAN

LOAD BUILDING





LIGHTING REQUIREMENTS in these two gymnasiums were fixed by basketball, naturally. In the large college gymnasium (left) players and spectators can always see the ball clearly without being conscious of the lighting. In the smaller high school gymnasium (truss only 28 ft from floor) the same condition prevails. Different solutions for the two different problems produced the same result in each case

High Bay and Low Bay Gymnasium Lighting

S. B. LeCORNU
Nashville Electric Power Board
Nashville, Tenn.

THAT THE BALL shall be uniformly and clearly illuminated in passing and throwing throughout the game is the basic requirement of basketball lighting. How this requirement is met under two different sets of conditions is shown in the installations in the gymnasiums of David Lipscomb College and of Central High School in Nashville.

The large gymnasium at David Lipscomb College seats 5,000 spectators when both main floor telescoping seats and balcony permanent seats are filled. The first floor area is 116 x 66 ft and the height from floor to arched truss at middle point is 48 ft. Since this is an exhibition type basketball floor, maintenance of a foot-candle level of 60 to 70 was decided upon. To attain this level of illumination, a Holophane high-bay unit was used with 1,500-w lamps. The reflector has a concentrating distribution with a spacing-mounting height ratio of 0.75. Since the area per unit is only 250 sq ft, the light distribution of the unit put the illumination most efficiently on the playing area. The units are mounted between the trusses at heights following the arch of the bottom chord of the truss. Since the ceiling is unfinished, it was thought best not to allow any spill light to go upward. The resultant illumination was 95 ft-c initial, and because of the high shielding angle of 55 deg there is no discomfort from the 1,500-w source at normal viewing angles.

The Central High School gymnasium is of flat truss construction. Since the bottom of the truss is only 28 ft from the floor and a fairly high foot-candle level was desired, a 500-w medium spread Holophane lighting unit was the choice. The unit is mounted between the trusses level with the lower chords. Since the fixtures are quite low relative to the plane dimensions, unit covers were left off to allow spill light to illuminate the ceiling. This reduced the apparent source brightness by causing it to be seen against a light background. With the spacing and distribution used, the rays from adjacent units cross some 15 ft above the floor, thus illuminating the ball equally as well at this height, as on the floor. When too narrow a light spread is used, the dark spaces between units will cause the ball to look as though it were faster, and then slower in the brighter areas beneath the units. The resultant initial illumination here was 45 ft-c, and 30 or more will be delivered even with a minimum of maintenance.

We Had Them Here, Too

THE YOUNGER GENERATION of men concerned with the design and operation of generating stations do not have much idea of what their field was like in its earlier days.

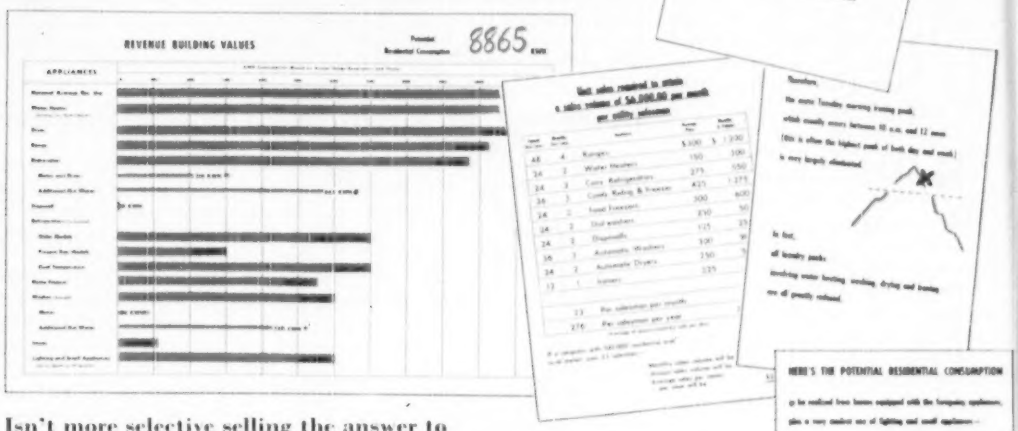
Although this story comes from Sweden, its parallel could be related many times about early power plants in this country. It is an abridgement of informal reminiscences by M. Hartwig at a Swedish engineering society meeting, as published with the drawing in the technical magazine *ERA*, Stockholm, and translated by Conrad Jacobson, Glen Ridge, New Jersey.

"One day in my youth when I was walking along Vassgardaalven River fishing for trout, I discovered in the

"Hotpoint's new load-building study is a powerful aid in planning a productive sales program."

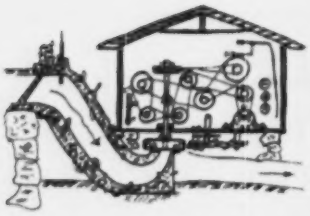
Robert C. Hienton
General Sales Manager
The Cleveland Electric
Illuminating Company

...thank you, Bob Hienton. We believe every utility sales executive who sees it will agree with you.



Isn't more selective selling the answer to building *balanced* revenue? Have you a definite, up-to-date sales program based on the best objectives for your company? What are other utilities reporting about dealer sales and cooperation? What is a practical and economical approach to "low-KWH" customers? These and many other questions are authoritatively discussed in Hotpoint's new, up-to-the-minute analysis of utility sales based on load balancing. The result of many recent surveys and inquiries—designed especially for executives concerned with the success of utility sales management, it is a distillation of the best and most progressive thinking in its field. To arrange for a presentation to your sales executive group, contact the Hotpoint Utility Division, Hotpoint, Inc., 5600 West Taylor Street, Chicago 44, Illinois.

Hotpoint
(A GENERAL ELECTRIC AFFILIATE)



HYDROELECTRIC plant of primeval times

neighborhood of Björkebol a little building where water was running from under the foundation. I went around to the other side. There was a little dam and from this dam a cement chute that connected with the building. The whole seemed to be really intriguing so that I walked to the nearest house and inquired if I could have a look. The owner followed me down to the power station which showed itself to be composed of numerous belts and shafts, also a small generator in one corner.

"I wondered if the owner would be willing to start up for a short while. He would gladly do so. He then walked outside of the building and hollered to a house nearby, telling Emma to put the electric iron on. He informed me that he had to have a small load for the generator when starting, otherwise the voltage would rise too high and all the electric lamps in the neighboring houses would burn out. Then he walked into the power station and operated a crank and nothing happened. 'There no doubt is a little junk in the turbine which I have to remove,' he said, and opened a trap door in the floor and with a boat hook pulled out a lot of pine twigs and peat from the turbine. After cleaning and after the turbine had received several shoves with the boat hook, it gradually started. Little by little it came up to full speed with all the belts flapping and the generator running with a scream. After a while, I signalled to the owner that I was satisfied. He walked over to the crank and began turning it backward, when a terrible noise started which lasted for a few seconds, and then all was quiet. I then looked down through the trap door and discovered that the noise came from the brake mechanism which consisted of a log which was cranked into the turbine wheel."

EDITH EDMOND AND ROSS COCHRAN, both of the Commonwealth Edison customer department, show how electric demonstration cabinet is used. Mr. Cochran points to dial which gives cost of electricity used hourly, in this case by an electric roaster

Not Average, But Specific, Cost of Appliance Operation

How much does it cost in a particular Chicago home for electricity to light a 60-w bulb? How much to operate an electric clock? Or an electric blanket? Or a radio? Or a fan?

A specially built demonstration cabinet now in operation in the Commonwealth Edison Co Electric Shop, 72 West Adams St, gives an immediate answer to the customer—based on his individual light bill.

A large cabinet contains the light bulbs and appliances. One panel of the cabinet holds six incandescent light bulbs ranging from 15 to 300 w, one fluorescent tube, a doorbell, and a doorbell transformer. Inside the glass cabinet are seven appliances: a clock, blanket, iron, roaster, food mixer, radio, and fan.

At the request of a customer, an attendant sets a gauge based on the amount of electricity the customer uses and then plugs in the appliance selected, which appliance immediately starts to operate. A meter at once registers the cost of operating the device in terms of cents; or, in many cases, fractions of a cent per hour are registered.

Here's a Heavy Heater Load

One might say that after many years of successful experimentation electric heating is at last taking concrete form. Because it actually is in Australia. The municipal electric system in Melbourne is promoting the use of concrete block electric heaters.

The Melbourne system is temporarily short of capacity, so the idea of storage-type heaters was eagerly grasped. Three models were developed, each consisting of a concrete block with holes through which nickel-chromium wire is threaded. One is rated at 750 w and weighs 90 lb. The others take 1,600 and 2,300 w weighing 150 and 300 lb.

Connected in off-peak hours, the concrete block reaches a temperature of 800 to 900 F. By late afternoon the temperature is down to 200-300 F. Observations indicate that a properly-sized heater can maintain average room temperature at about 10 deg above average daily mean temperature. Efforts to devise means to control heat emission from the block have been unsuccessful.

The National Telephone Supply Company

5100 SUPERIOR AVENUE • CLEVELAND 3, OHIO

Canadian Mfr.: N. SLATER CO., LTD., HAMILTON, ONTARIO, CANADA

Export Distributor: INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N. Y.

NEW EQUIPMENT

Liquid Fuse Mounting

BY RECESSING THE END INSERTS in the porcelain of a new single-insulator mounting for the S&C liquid fuse, leakage and arcing distances are said to have been increased. The mounting and liquid power fuse combinations are available in ratings of 7,500 and 15,000 v, ½E to 125E amp; and with short circuit interrupting ratings of 3,900 to 8,600 amp, rms, asymmetrical.

Clips are designed for handling the fuse with a hook stick from a pole, a structure, or the ground. The hangar on the upper clip aligns the fuse on both clips, and holds the fuse in the mounting if it should be closed in on a faulted circuit. Blast action, which occurs with heavy fault currents, is from top of the fuse, away from the operator.

S&C Electric Co, 4421 Ravenswood Ave, Chicago, Ill.

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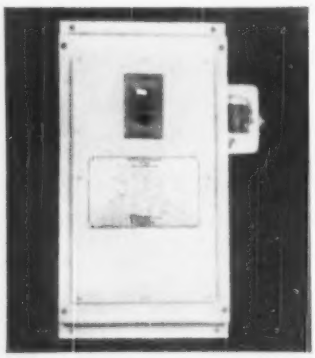

Temperature Loading Relay

AIR-COOLED TRANSFORMERS, Type ASL Class "B" insulated, can be supplied with a relay for starting cooling fans and operating alarms as transformer loads increase beyond normal self-cooled ratings. A selector switch on the relay provides either manual control or automatic operation using the relay.

The first of two bimetal tripping devices is calibrated to start the cooling fans when maximum safe self-cooled transformer operating temperature is approached. If the fans fail to start and the load continues to increase, a second bimetal operates at a slightly higher temperature to energize an alarm circuit before limiting temperature is approached. The bimetals reset automatically if the load decreases. Fans are shut off by a current relay when load becomes less than 100% transformer rating.

A 60-cycle, 240-v source is required for operation of the relay.

Westinghouse Electric Corp, P.O. Box 2099, Pittsburgh 30, Pa.

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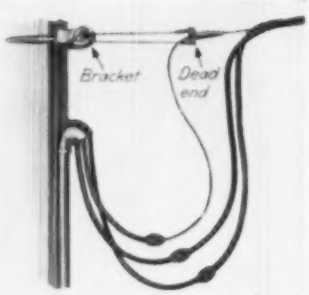
Ground Rod

A SLOTTED, BOLT-TIGHTENED WEDGE reportedly makes a quickly assembled, permanent and positive connection between conductor and ground in a new drive head ground rod. Ground connection is made by inserting the conductor in the slotted plug and tightening the bolt through the plug, wedging the ground wire tightly to the rod. The rod is made of high carbon steel and is galvanized to resist corrosion; it has a flat head and pointed end to facilitate driving.

A. B. Chance Co, 210 Thomas St, Centralia, Mo.



Dead End & Anchor Bracket

A SERVICE-DROP automatic dead end has been announced for use with preassembled messenger-supported cable. Assembled as a one-piece unit, the Series 3800 dead end has one end of the flexible bail detachable for installation around a spool-type insulator or other supporting anchorage. This permits installation with only one part, other than the conductor, to be handled by the lineman. The dead end grips the bare neutral or messenger, eliminating the possibility of shorting phase wires.

The 4000 Series service-drop anchor bracket (also shown), for use in anchoring service drops, permits insertion of a closed bail or loop without opening the loop. This one-piece unit supports the cable at practically any angle and is said to reduce installation costs.

Electroline Co, 4121 S. La Salle St, Chicago 9, Ill.

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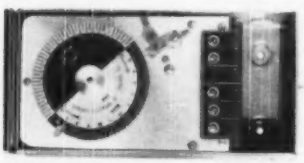


Time Switch

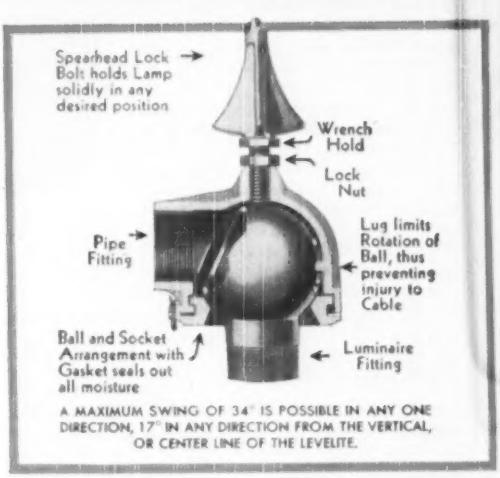
TIMER OPERATIONS of a new time switch are adjustable to within 15 min over the 24-hr movement. Operation trippers are attached to the dial by thumb screws. The switching mechanism operates in a forward direction

the ADJUSTABLE END FITTING *for* PIPE ARMS

The Hubbard LEVELITE has been designed to provide a much needed flexibility on street lighting installations. Luminaires may be leveled or purposely tilted in any direction, and permanently locked in that position. Many problems in lighting can be solved by this fixture. Poles which are set some distance in from the curb might require a tilt away from the pole to throw more illumination to the roadway. Special conditions such as building obstructions, landscaping, consisting of trees which it is preferred not to trim, and instances where unforeseen changes occur after lines are in service can usually be handled in a practical manner by LEVELITE flexibility.

Mechanical working of the Hubbard LEVELITE is explained by the illustration at the right. A ball and socket movement is used, effectively sealed by a lead gasket. Rigid setting in position is maintained by a single "spearhead" bolt and lock nut. Changes may be made easily and quickly before, during or after installation.

A most popular combination is the HUBBARD LEVELITE and the new HUBBARD UPSWEEP Street Lighting Brackets. Write for a copy of the Hubbard Linebuilder describing these Brackets if you have not already received a copy.


Spearhead Lock Bolt holds Lamp solidly in any desired position
Wrench Hold
Lock Nut
Pipe Fitting
Lug limits Rotation of Ball, thus preventing injury to Cable
Ball and Socket Arrangement with Gasket seals out all moisture
Luminaire Fitting
A MAXIMUM SWING OF 34° IS POSSIBLE IN ANY ONE DIRECTION, 17° IN ANY DIRECTION FROM THE VERTICAL, OR CENTER LINE OF THE LEVELITE.

Stock No.	For Pipe Arm Nominal Size—Inches	Luminaire Attachment Thread—Inches	Approximate Shipping Wt., Lbs., 100 Pcs.
3279	1¼	1¼ (pipe)	563
3281	2	1¼ (pipe)	900
3282	2	2 (pipe)	944

HUBBARD AND COMPANY

PITTSBURGH · CHICAGO · OAKLAND, CALIF.

with the dial movement. It is available for 20-amp loads as standard on 115 v a-c and 15 amp, 230 v, 60 cycles.

Lumenite Electronic Co, 407 S. Dearborn St, Chicago 5, Ill.

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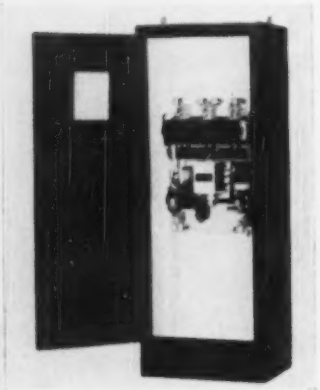

Solenoid Starters

TWO LARGER UNITS have been added to the Bulletin 709 line of a-c, across-the-line solenoid starters. Size 6 is rated at 600 amp, 200 hp, 220 v; 400 hp, 440/550 v. Rating of Size 7 starter is 900 amp, 300 hp, 220 v; 600 hp, 440/550 v.

Both units have the one-piece magnetic plunger which operates with a vertical straight line motion. The solenoids are energized with direct current drawn from a self-contained selenium rectifier, and are equipped with adjustable thermal overload relays. All terminals and wiring are said to be accessible from the front.

Allen-Bradley Co, Milwaukee, Wis.

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Dual Oscilloscope

TWO INDEPENDENT and rapid phenomena occurring simultaneously can be observed and analyzed with the new H-21 dual-channel oscilloscope. Such variables as speed and vibration, input and output signals of amplifiers, and velocity and acceleration are typical comparisons.

The two variables are brought together on a single oscilloscope as two separate traces through use of two complete electron guns in a single 5-in. flat face tube.

Triggering is in continuous sweeps from 2 cps to 50 kc, ½ sec to 20 microsec; range is up to 100 v. Unit is about 14x17x21 in., weighs 65 lbs.

Electronic Tube Corp, 1200 E. Mermaid Lane, Philadelphia, 18, Pa.

Temperature Indicators

A NEW LINE of temperature indicators for industrial and laboratory use includes cold-end compensated thermocouple thermometers for measuring temperatures up to 3,000 F and resistance thermometers for temperatures up to 300 F.

The thermocouple thermometer is available in two sizes, with either a 3½ or 2½-in. flange. It can be used in industrial furnaces, infrared drying ovens, kilns, and melting pots.

Resistance thermometers, designed for measurement of low temperatures where high accuracy is important, are available in two types: DB-15 long-scale instruments and Types DD-6 and DD-7 six-inch rectangular, surface and flush-mounted instruments. They are suitable for measuring winding temperatures of transformers and generators, and for bearing temperature indications. Complete details in Bulletin GEC-565.

General Electric Co, Apparatus Dept, Schenectady 5, N. Y.

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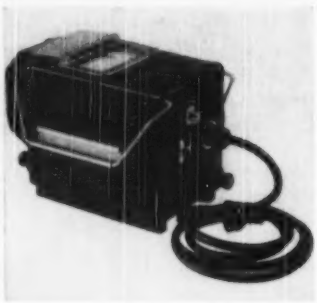
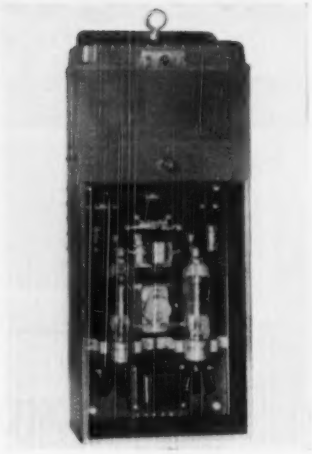


Insulation Tester

PRODUCTION TESTING of electrical equipment can be performed with a rectifier-operated Megger insulation resistance tester. The "power-pack" of this instrument consists of a constant-voltage step-up transformer and selenium rectifier. The constant-voltage feature reduces pointer fluctuations that may occur when testing large generators or long cables having appreciable capacitance. A switch pilot light and connecting cable are included.

Other suggested uses of the instrument include: Testing control circuits and other equipment in power plants, testing extensive lighting and power installations, testing railway signal installations, and experimental and laboratory use. A full description is given in Bulletin 21-46-9.

James G. Biddle Co, 1316 Arch St. Philadelphia 7, Pa.



Rectifier

XENON GAS-FILLED TUBES are used in the 2T Series of single-phase tube type rectifiers designed for use in conjunction with alternators, electromagnets and separators, electrolytic equipment, dynamometers, electrical testing equipment and other industrial requirements were d-c is necessary.

These units incorporate insulated filament transformers, synchronous motor timer, fuses, and terminals, mounted on an ebony panel board. Wall mounting housings are 16 gage steel, louvered, and having knockouts for conduit connections.

Dual a-c input voltages are 115/230 or 230/460 v. Available d-c outputs are 115 or 230 v, in capacities ranging from 115 w to 3,680 w. Ambient temperature limits are —40 to 125 F. Details are in Bulletin 200.

Accurate Engineering Co, 2005 Blue Island Ave, Chicago 8, Ill.

•

Switch Mechanism

A MOTOR OPERATING MECHANISM, torsional output type, for outdoor air brake and disconnecting switches is available in a wide range of operating voltages. The mechanism drives the air switch by means of a single-phase or d-c motor, operating though a gear to give proper operating speed. Auxiliary switches may be obtained for operation of indicating lamps, electrical interlocks, and relay circuits.

The gear train can be uncoupled from the output shaft to allow manual operation of the air switch with a removable operating handle. By moving a pin, the auxiliary switches can be coupled to either the main switch or to

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

Why is this hard to read?

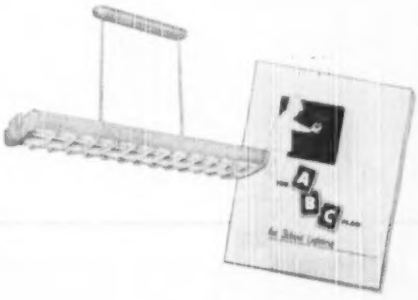
The circle tells its own story of a common classroom problem. But shadows are only one of many classroom lighting problems.

Since each classroom lighting situation is different, there is no "cure-all" lighting fixture on the market today. For best results, determine which factors bear the highest priority in your customer's situation, then plan a complete lighting system for best results.

This story—a customer's approach to classroom lighting problems—is in the ABC Plan for School Lighting, B-4556.

This story and this book are being advertised monthly to school executives—your customers. Why not join us in spreading this story from coast to coast?

Name any lighting problem—we have the fixtures and know how to apply them—and ONE will be the BEST BUY for you and your customer. J-04251-B



Write Westinghouse Electric Corporation
P. O. Box 868, Pittsburgh 30, Pa.

Westinghouse
PLANNED LIGHTING PAYS

EISLER TRANSFORMERS

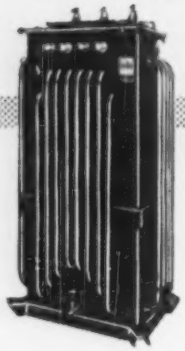
STANDARD • SPECIAL

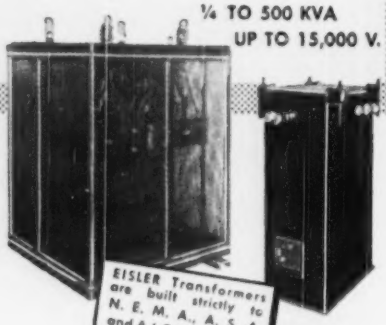
AIR • OIL • WATER-COOLED

for

POWER DISTRIBUTION • LIGHTING •
AUTO • ELECTRIC FURNACE •
HEATING • PHASE CHANGING •
WELDING • GENERAL PURPOSE

¼ TO 500 KVA
UP TO 15,000 V.



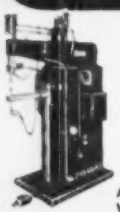


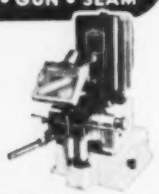
EISLER Transformers are built strictly to N. E. M. A., A. S. A. and A. I. E. E. standards.

In addition to the manufacture of standard transformers the Eisler organization is especially well adapted to design and build transformers to the customer's specifications when departure from standard construction is desired. Send in your specification for quotations.

SEND FOR NEW CATALOG TR-50

EISLER
RESISTANCE WELDERS
SPOT • BUTT • GUN • SEAM





A complete line of Resistance Welders from ¼ to 300 KVA for all types of welding.

CHAS. EISLER, Pres.

EISLER ENGINEERING CO. INC.

769 SOUTH 13th ST. NEWARK 3, N. J., U. S. A.

the mechanism during manual operation or testing. The mechanism can be recoupled to the air switch only when mechanism and switch are in the proper relation for normal operation.

The cover of the weatherproof sheet-steel housing can be removed to give access to two sides and the front of the mechanism.

Westinghouse Electric Corp, P.O. Box 2099, Pittsburgh 30, Pa.

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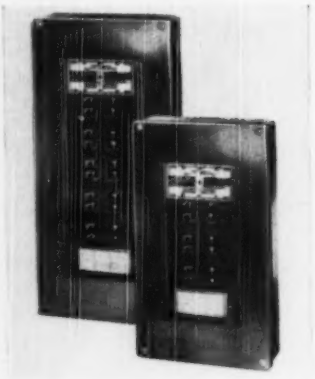


Multi-Breaker Load Centers

THE "PLUG-IN" FEATURE of Multi-breaker load centers, for lighting and appliance circuits, reportedly makes it possible to add or change circuits conveniently. They are available with flush or surface type mounting covers, 3-ph, 4-w arrangement.

Type MO 12 gives from 2 to 12 circuits when thermal-magnetic multi-breaker units are plugged on to the basic bus bar structure. The units can be had in ratings from 15 to 50 amp, 120/240 v a-c.

Type MO 20 is similar to Type MO 12, but has space for up to 20 circuits.

Square D Co, 6060 Rivard St, Detroit 11, Mich.

•

Electrosensitive Paper

A LOW VOLTAGE, current sensitive paper which can record transients of 30 microseconds duration has been developed. The paper is used with the helix type of recorder or adapted to existing stylus recorders.

Three types of Alfax paper are available: Type "A" records in a brown trace on a white background at writing speeds up to 18,000 in. per min; other types record a black trace on a white background at speeds up to 700 in. per min.

Suggested as users of the paper are engineers, research groups, and instrument manufactures. It can be used for control purposes in conjunction with the

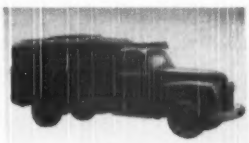
POWERS GENERAL SERVICE BODIES

The versatility of these POWERS Bodies permits them to be used for gas, telephone, water and electric service; street light maintenance, and other types of general service work. Large, weather-tight compartments are fitted with shelves, parts bins, and material hooks to provide facilities for the tools, supplies, and equipment required on almost any job. Standard models are available for installation on ½, ¾, and 1 ton chassis.

POWERS Bodies are also available for construction, maintenance, and service operations in all phases of the public utility industry. Write for complete information.

SERIES 700-C — Forestry Body. Crew compartment comfortably accommodates four men. Winch and derrick optional.

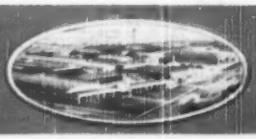
AD-10—Pole Dinkey. Has 1 ton capacity. Other models having capacities up to 5 ton are also available.



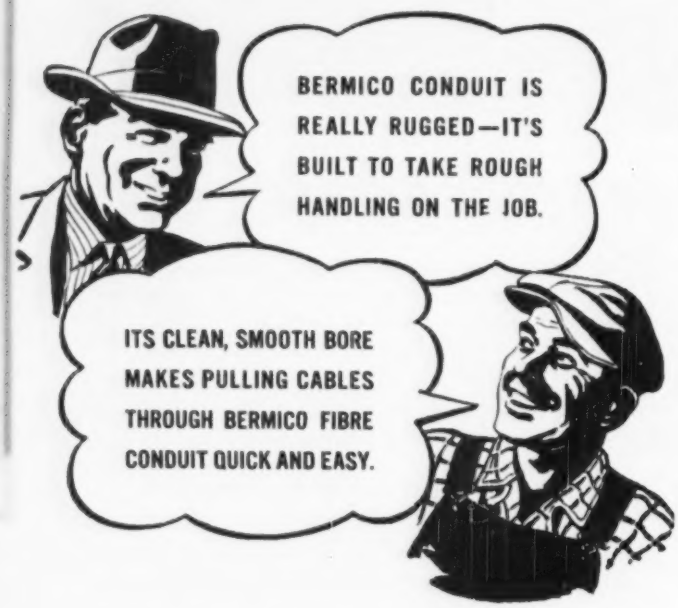
SERIES 500 — Line Construction and Maintenance Body. Various models are available for all standard truck chassis.

ALL-STEEL POWERS Public Utility Bodies

UTILITY BODY DIVISION
McCABE-POWERS AUTO BODY CO.
5900 N. BROADWAY • ST. LOUIS 15, MO.



BERMICO* FIBRE CONDUIT


BERMICO CONDUIT IS REALLY RUGGED—IT'S BUILT TO TAKE ROUGH HANDLING ON THE JOB.
ITS CLEAN, SMOOTH BORE MAKES PULLING CABLES THROUGH BERMICO FIBRE CONDUIT QUICK AND EASY.

distributed by
WESTINGHOUSE ELECTRIC SUPPLY COMPANY
Offices in all leading cities

BERMICO FIBRE CONDUIT—A PRODUCT OF BROWN COMPANY

electric eye, for direct recording computer results, monitoring frequencies, and facsimile reproduction of copy, photographs, or halftones.

Alfax Paper and Engineering Co, 40 Riverside Ave, Brockton, Mass.

•

Service Entrance Switch

DESIGNED FOR USE as an over-all main disconnect switch in factories, stores, and homes is a 100-amp, double-pole, fuseable pullout switch. It is available singly in raintight steel cabinets, or in combination with up to 20 single-plug fuse branch circuits and either one or two 30 or 60-amp branch switches.

General Switch Corp, 49 Roebling St, Brooklyn 11, N. Y.

MORE NEW PRODUCTS
about which you should know

BLACKHAWK MFG CO, MILWAUKEE 1, WIS., offers a thin-wall **conduit bender**, S-34, for 1¼, 1½ and 2-in. conduit; it is hydraulically operated and remote-controlled. . . . ELECTRICAL INDUSTRIES, INC, 44 SUMMER AVE, NEWARK 4, N. J., has a sealed lead and multiple **header kit** containing 81 standard hermetically sealed terminals and 11 stock header types.

IRON FIREMAN MFG CO, PORTLAND, ORE., has designed a fuel **oil feeder regulator** for industrial oil burners using any weight fuel oil. . . . CAUHORN DISTRIBUTING CO, 9999 BROADSTREET, DETROIT 4, MICH., has a device which plugs into a-c or d-c outlets, 110-115 v, to heat **deodorant** or medicated cakes, and circulates the air in the room.

GEORGE ULANET CO, 410 MARKET ST, NEWARK 5, N. J., has a miniature **thermostat** having a volume of less than

KEARNEY PRODUCTS

ARE

Laboratory Tested

TO INSURE EFFICIENCY

Field Tested

TO INSURE LONG SERVICE LIFE

Every piece of overhead and underground utility equipment bearing the James R. Kearney trademark, comes to you only after it has been thoroughly laboratory and field tested . . . your assurance that Kearney Products will do the job you expect them to do once they're installed. And dollar for dollar you can't buy a better piece of equipment because Kearney still gives you "A Little More For A Little Less Through Engineering."

JAMES R. KEARNEY CORPORATION

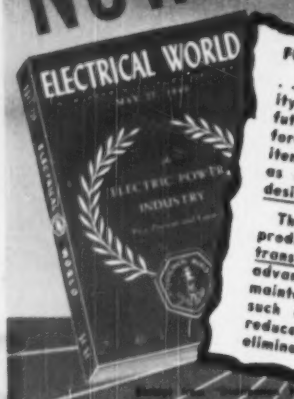
4224-42 Clayton Ave., St. Louis 10, Mo.

Canadian Plant: Guelph, Ontario

Always Specify JAMES R. KEARNEY CORPORATION ST. LOUIS, MO. *for the Job...*

Better Construction — *SAFER* Maintenance

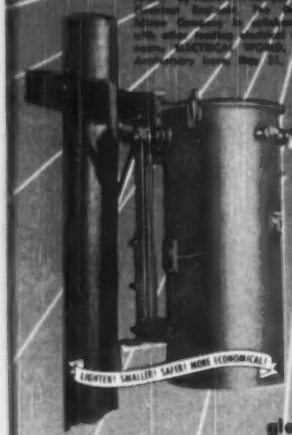
NOW! the transformer of the future



FUTURE POSSIBILITIES

. . . It is to be expected that such activity (improvements) will continue in the future. Much of it can probably not be foreseen at this time. There are a few items, however, which might be mentioned as either distinct possibilities or highly desirable.

There is considerable promise of the production of a dry-type distribution transformer for pole top installation. The advantage will be less weight and lower maintenance. It seems possible that on such a transformer the case might be reduced to a minimum or perhaps be eliminated entirely.



MARCUS
DRY TYPE AIR COOLED
DISTRIBUTION TRANSFORMERS

Months before the publication of this excellent article on distribution transformers, Marcus, a pioneer in the field, announced a new line of all purpose dry type distribution transformers for indoor or outdoor service.

The complete absence of hazardous oil or toxic liquid affords safety never before realized. Superior Class B and C heatproof insulation, such as fibreglass, mica, porcelain, new Johns-Manville Quinterra, etc., results in overload capacities unobtainable with Class A oil filled units. The entire transformer element is seal protected against oil, acids, moisture, etc., and is housed in a sturdy, scientifically ventilated, weather proof case which conforms with all applicable EEI-NEMA construction standards. This extremely versatile transformer can be used outdoors, pole or platform mounted or indoors at the load center, mounted wherever convenient with no expensive fireproof vault required.

Currently available in sizes to 100 KVA, voltages to 5000 V.

AIR-COOLED TRANSFORMERS EXCLUSIVELY
1 to 2,000 KVA up to 15,000 Volts to meet Individual Requirements
- DISTRIBUTION
- GENERAL PURPOSE
- UNIT SUBSTATION
- PHASE CHANGING
- ELECTRIC FURNACE
- RECTIFIER
- WELDING
- MOTOR STARTING

Write for Bulletin #49-ACO

COMPETITIVE PRICES MTC ISOCO DELIVERIES

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MARCUS TRANSFORMERS CONFORM TO THE STANDARDS OF N E M A AND A I E E

Representatives in Principal Cities

MARCUS
TRANSFORMER CO.
INC.
32 MONTGOMERY STREET
HILLSIDE 5, NEW JERSEY

PIONEERS IN THE FIELD OF AIR COOLED TRANSFORMERS

¼ cu in. for adjustments from 0 to 400 F. . . . Empire Development Corp, 52 Broadway, New York 4, N. Y., has a Draw-In-Dex **cabinet** for filing and locating quickly 1,000 blueprints.

Allied Control Co, Inc, 2 E. End Ave. New York 21, N. Y., has a new line of **relays** including its general-purpose "BO" relay. . . . Electric Sprayit Co, Sheboygan, Wis., has designed a portable **spraying unit,** Series 270, for paints and chemicals; it weighs 39 lb and is operated by a ¼ hp motor.

Edwin L. Wiegand Co, 7513 Thomas Blvd, Pittsburgh 8, Pa., is producing a new portable tank **immersion heater** for oil and water solutions, tars, etc; heaters are rated from 2 to 18 kw, 115 or 550 v, single or 3-phase. . . . All-State Welding Alloys Co, Inc, 273 Ferris Ave, White Plains, N. Y., is making flux-coated nickel-silver **brazing rod** for application with the oxy-acetylene blowpipe on copper, steel, and copper nickel.

General Electric Co, Construction Materials Dept, Bridgeport 2, Conn., is manufacturing a **utility unit** for remote-control of small motors and heating and lighting equipment; relay has rated capacity of ⅓ hp, 15 amp, 125 v or 5 amp and 250 v a-c. . . . The Haas Corp, Mendon, Mich., has a new desk model **magnifier** that consists of a 5-in. lens set in a plastic head with two fluorescent lights built in on the underside.

The Electric Controller & Mfg Co, 2700 E. 79th St, Cleveland 4, Ohio, has developed a dynamic braking crane bridge-stop **control** that converts driving motors into generators to stop the crane quickly in case of power failure. . . . Federal Tool and Mfg Co, 3620 Alabama Ave, Minneapolis 16, Minn., is making die-stamped **nameplates** in sizes up to 9x12 in., 3/32 in. thick; can be chromed or nickel plated.

Sola Electric Co, 4633 W. 16th St, Chicago 50, Ill., has announced the "75" fluorescent **ballast** that is designed for two T 12, 96-in. slimline lamps, 95 to 130 v. . . . Sudenga Iron Works, George, Ia., has a 26-lb portable **drill press** designed for use with ⅜ to ½ in. electric drills.

Leeds and Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa., is manufacturing the Thomas Autometer for continuously recording **concentration of sulfur dioxide** in parts per million; also records average 30-min concentration, marks off each cubic foot of air samples, and automatically checks its "zero reading" every 30 min.

ROCKBESTOS A.V.C.® CARRIES 32% GREATER LOAD

YET BOTH ARE THE SAME SIZE

Compare A.V.C. with Type RH in a 250 MCM size*

Size for size A.V.C. has a HIGHER AMPERE RATING

Hi

YOUR BEST BUY

- you use 2½" conduit for both
- you use the same size fittings and lugs
- you have the same installation costs
- BUT Type RH carries only 224 amperes whereas higher-rated A.V.C. carries 296 amperes—a 32% increase in capacity.

For more efficient current-carrying capacity, always specify Rockbestos A.V.C. Write for the booklet "Cut Current Carrying Costs."

*From Chapter X—National Electrical Code—3 conductors in conduit—40°C-104°F.

ROCKBESTOS A.V.C.

ROCKBESTOS PRODUCTS CORPORATION NEW HAVEN 4, CONN.

NEW YORK CLEVELAND DETROIT CHICAGO PITTSBURGH ST. LOUIS LOS ANGELES OAKLAND, CAL.

DEPENDABLE

for power generation in main plants of small and medium size utilities.

for voltage booster stations at the end of long transmission lines—to act as two-way power feed when line trouble is encountered in storms, overloads, and other circumstances.

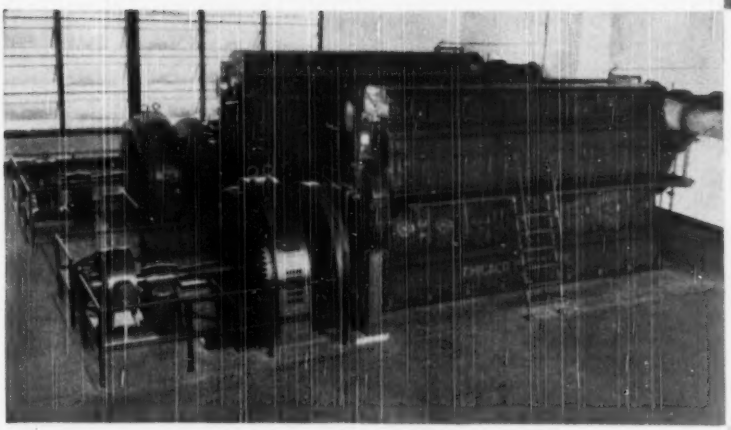
for semi-portable or portable units for emergency hook-ups during transmission line repairs and replacements.

for installation in communities where a local generating plant may be an important element in franchise negotiations.

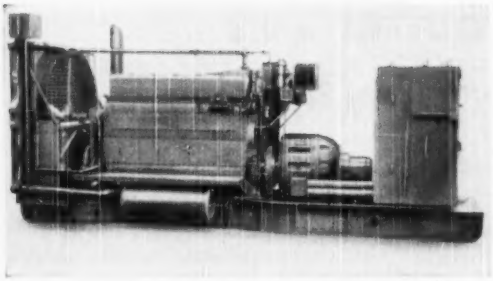
for power units in central station plants of large utilities.

For these various purposes Chicago Pneumatic provides a complete line of Diesel and Dual Fuel Units ranging from 100 to 1200 KW. Write for full information.

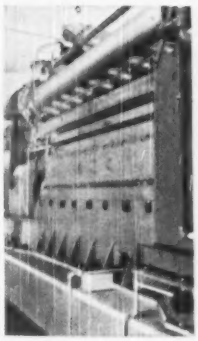
CP diesel and dual fuel engines

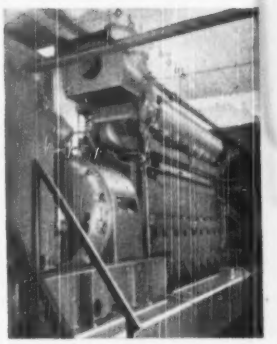


A key generating plant of prominent midwest utility.



Package unit as used in temporary installations during transmission line repairs and replacements.



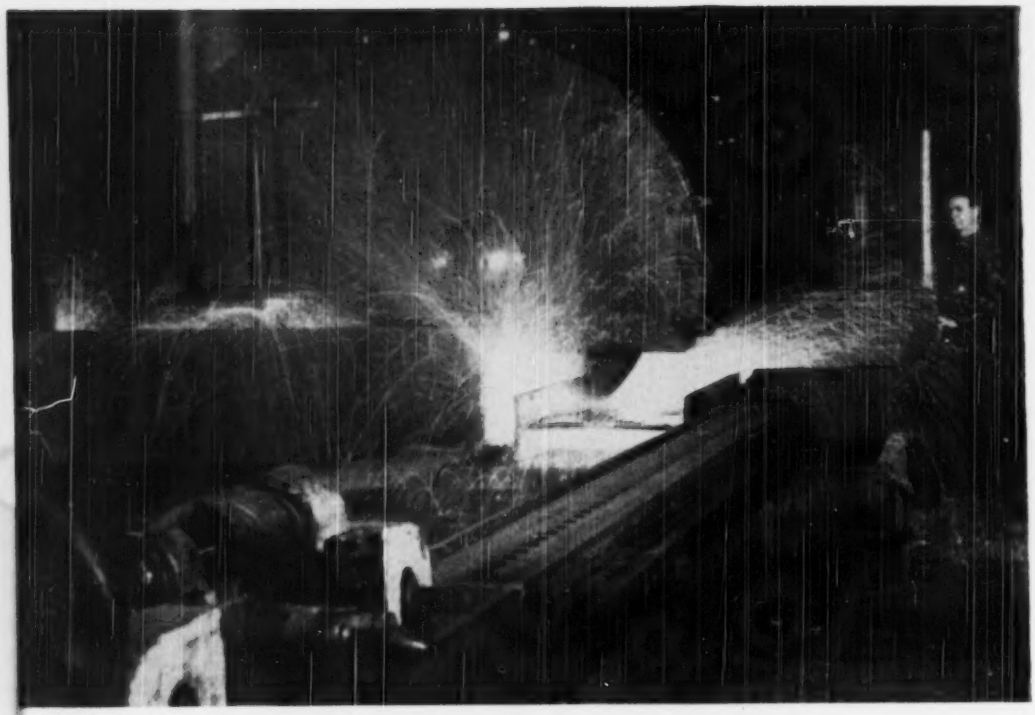


Typical small community installation on end of a transmission line, providing voltage regulation and two-way power feed.

CHICAGO PNEUMATIC TOOL COMPANY

General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES



Cuts Beams Like Butter . . .

To Give You Quick, Accurate Steel Service

Biting through a 24 inch beam at a Ryerson plant, this big friction saw completes the cut in 11.6 seconds—literally cuts cold steel like hot butter. The speed of the cut results in the very minimum of burr and a new method of maintaining blade alignment assures a straight, true edge.

This new saw is typical of the equipment that's ready to work for you at your nearby Ryerson plant. Another—a new metal saw with a big 18 x 18 inch capacity. Using high speed hack saw blades, it cuts bar steel to close-tolerances, and every cut, square or angular, has an unusually accurate surface.

Then there's the flame-cutting machine, with an electric eye to follow your sketch or blue-print, which cuts irregular shapes with amazing accuracy—to within fifteen thousandths of an inch! These machines, and many others, work for you as your own when you call us for steel from stock.

No other steel service organization in America is better equipped. Few can serve steel buyers nearly as well. For steel cut *exactly* the way you want it, get in touch with our nearest plant.

PRINCIPAL PRODUCTS

BARS—Carbon & alloy, hot rolled & cold finished
STAINLESS—Allegheny metal plates, sheets, bars, etc.
STRUCTURALS—Channels, angles, beams, etc.
PLATES—Sheared & U. M., inland 4-Way Floor Plate
TUBING—Seamless & welded mechanical & boiler tubes
SHEETS—Hot & cold rolled, many types & coatings
MACHINERY & TOOLS—For metal working

RYERSON STEEL

RYERSON CERTIFIED STEELS

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • DETROIT • CINCINNATI
CLEVELAND • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO

NEWS ABOUT PEOPLE

FIFTY YEARS OF SERVICE to the New England electrical industry are celebrated at Boston's Hotel Statler by associates of John J. Caddigan, assistant vice-president of Boston Edison, on the eve of his retirement. Boston Edison Pres James V. Toner, right, presents a folio of 50 U. S. Savings Bonds in recognition of Caddigan's record with the company

Personnel Shifts Made at Nela Park; GE Names Harroff Vice-President

Fred F. Harroff has been elected a vice-president of the General Electric Co as one of a series of personnel shifts being made in the Lamp Department at Nela Park, Cleveland.

Harroff, who retains his position as general manager of the Lamp Department, succeeds Martin L. Sloan, who has retired. Other Nela Park retirements include Dr Matthew Luckiesh, director of GE's Lighting Research Laboratory for the past quarter century, and Harold D. Blake, technical director of the Lamp Development Laboratory.

A veteran of 29 years in the department, Harroff spent 10 years in the sales operation division, then was transferred in 1931 to the administrative division. In 1943 he became assistant general manager of the Lamp Department and last year general manager.

During the war he was responsible for coordinating manufacturing activities of the department. Much of his time has been devoted to operational analysis, and his studies have been applied to sales and service policies and plans and organizational structures.

Luckiesh is generally regarded as one of the world's foremost authorities on light, color, lighting, and vision. His studies served as the basis for the Better Light-Better Sight movement. He pioneered in the study of the entire field of the visible spectrum and explored invisible infrared and ultraviolet energy. His findings in these fields are included in 24 books and hundreds of technical papers.

Luckiesh's most recent book, "Applications of Germicidal, Erythemal, and Infrared Energy," is being used as a guide to practical use of radiant energy for human welfare. Most recently his researches have been devoted to use of germicidal energy in the killing of airborne and waterborne bacteria.

He joined GE in 1910 as a physicist in the research laboratories of the Lamp Department in Cleveland. In 1920 he was made director of applied science and in 1924 director of the department's Lighting Research Laboratory. In addition to fundamental research Luckiesh conceived and directed many lamp and lighting developments, including the first accurate glass filters for production of artificial daylight; daylight lamps; flametint lamps; meters for measuring light, ultraviolet, brightness, visibility, and bacteria content of the air; and lighting recipes for residential, commercial, and industrial needs.

Active in the Illuminating Engineering Society, Luckiesh has been chairman of various committees, director, and president. He also belongs to the American Institute of Electrical Engineers, American Physical Society, Franklin Institute, and the Optical Society of America.

FRED F. HARROFF

Blake is retiring after 40½ years of continuous service. One of five original staff members of the Lamp Development Laboratory, he has been technical director for 30 years. He has been responsible for technical work involved in the development of new light sources.

•

William R. Putnam, who recently retired from Ebasco Services, Inc, as a director and general consultant, has joined Kidder, Peabody & Co as public utility consultant. He will work with firm members and research personnel engaged in the financing of operating

HEVI DUTY CONSTANT CURRENT REGULATORS for series lighting of

★ STREETS
★ AIRPORTS
★ SUBWAYS
★ HIGHWAYS

Proved savings on your series lighting system are possible by using the Hevi Duty Static Type Constant Current Regulator. The unique resonant circuit used transforms constant potential to constant current.

• *Take advantage of these features —*

99.5% Power Factor
95% *Actual* Efficiency
Increased Lamp Life
No Moving Parts
Low Maintenance

Write for details in Bulletin CCR-478

HEVI DUTY ELECTRIC COMPANY

HEAT TREATING FURNACES HEVI-DUTY ELECTRIC EXCLUSIVELY
DRY TYPE TRANSFORMERS — CONSTANT CURRENT REGULATORS
MILWAUKEE 1, WISCONSIN

public utilities. Connected with the public utility industry since 1899, Putnam is a former executive head of Idaho Power Co. He joined Electric Bond & Share Co and Ebasco in 1929. He organized and was first president of the Minnesota Electric Association and served as president of the Northwest Electric Light & Power Association and chairman of the National Electric Light Association's commercial section.

•

Metropolitan Edison Sales Post Goes to McQuiston

Theodore O. McQuiston, manager of residential sales for Duquesne Light Co, has been appointed sales manager of Metropolitan Edison Co.

One of the country's better known utility sales executives, McQuiston

THEODORE O. McQUISTON

gained national prominence as chairman of Edison Electric Institute's Electric Kitchen and Laundry Committee.

He joined Duquesne Light in 1925 as a contract clerk and began his sales career in 1931, when he became a lighting representative. He has since been sales research representative, sales promotion director, director of residential sales promotion, and residential sales manager.

McQuiston is secretary of the board of directors of the Electric League of Western Pennsylvania. Among other organizations in which he holds membership are the Illuminating Engineering Society, Pennsylvania Electric Association, the Pittsburgh Advertising Club, and Pittsburgh Housewares Club.

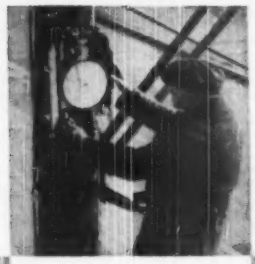
•

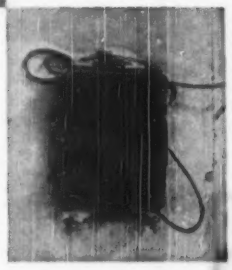
Dr. Albert W. Hull, who has been credited with the invention of more types of electron tubes than any other man, has retired as assistant director of the General Electric Research Laboratory. He will continue to serve the lab as a consultant. He joined the lab-

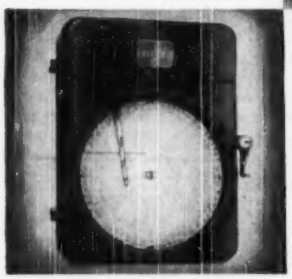
ILLUSTRATION FOR A

Detective Story

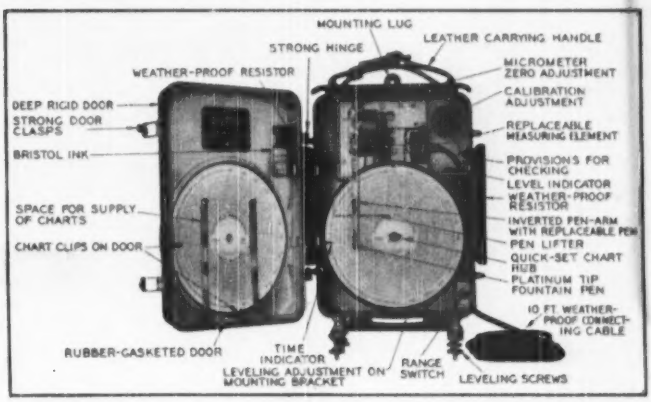
WITH A "PAY-OFF" EVERY DAY







You can put Bristol's All-Purpose Portable Recording Voltmeters and Ammeters *wherever* you need to get a clue as to what's going on in your power distribution system. The instruments are light, compact and weather-tight, suitable for portable service, indoors or out, for pole mounting, wall mounting or in damp cellars and manholes. Models available for permanent mounting on walls, panels and switchboards.



Many thousands of Bristol Electric Recorders—voltmeters and ammeters—are doing "detective work" under every kind of operating condition, helping—with famous Bristol accuracy—to uncover the facts needed for fast, efficient trouble-shooting. Many of the most progressive electric companies use them.

THREE PORTABLE MODELS

SINGLE PEN. Inexpensive instrument for quickly analyzing conditions, investigating complaints, making surveys, general testing, etc.

DOUBLE PEN. Records two different voltages or currents in two separate circuits simultaneously on one chart.

TRIPLE PEN. Records three different voltages or currents in three separate circuits simultaneously on one chart.

Many ranges carried in stock for immediate delivery.

Write for Bulletin E1100, giving full facts on Bristol Ammeters and Voltmeters, THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 91, Conn. (The Bristol Co. of Canada, Ltd., Toronto, Ont.; Bristol's Instrument Co., Ltd., Lynch Lane, Weymouth, Dorset, England.)

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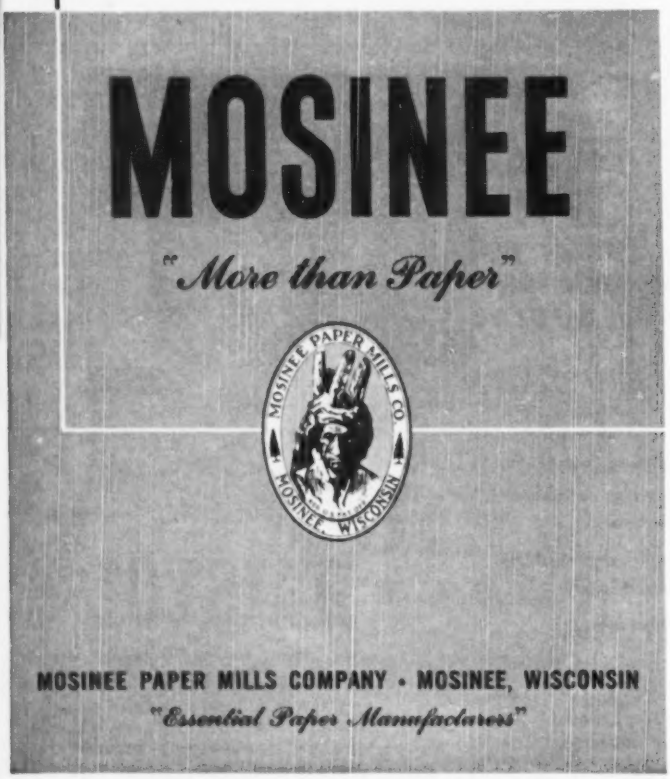
Gives You the FACTS When and Where You Want Them

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

MOSINEE doesn't count its success in terms of big volume records. More important to us is the aid that MOSINEE "paperologists" and facilities provide our customers.

If you have a problem involving paper . . . if you require specific technical characteristics such as high tensile or tear strength, accurate caliper, density, liquid repellency or absorbency, good dielectric strength, specified pH for maximum-minimum acidity or alkalinity . . . and above all, if you want to be sure of *dependable uniformity* . . . it will pay you to specify "MOSINEE." For consultation with MOSINEE technicians, without obligation to you, please write Dept. EW.



oratory in 1914 and became assistant director in 1928. Among his tubes are the magnetron, the screen-grid tube, and the thyratron.

•

NAED Adds Consultant, Traveling Representative

Two new staff members have been added to the headquarters staff of the National Association of Electrical Distributors (formerly NEWA).

J. G. Johannesen, a past-president of the Association, will serve in a special consulting capacity, and Philip M. Pritchard, most recently director of sales of Victor Electric Products, Inc, will be a special traveling representative.

Johannesen retired three years ago from the vice-presidency of General Electric Supply Corp. Before joining that firm in 1929 he was president of Southern Electric Co, electrical distributors in Baltimore, Richmond, and Charlotte.

Pritchard will serve as liaison between Association headquarters and the membership in the field and will make contact with non-affiliated distributors throughout the country. He has worked with RCA and Sylvania Electric Products, Inc, as well as Victor.

•

Kennecott Copper Corp Makes Cox President

Charles R. Cox has resigned as president of Carnegie-Illinois Steel Corp to become president of Kennecott Copper Corp, the world's largest producer of that metal. He succeeds E. T. Stannard, who was killed in an airplane crash in Canada.

C. T. Ulrich has resigned as chief executive officer, executive vice-president, and treasurer of Kennecott. He becomes chairman of the executive committee. E. S. Hann was elected treasurer.

Before becoming Carnegie-Illinois president, Cox was president of National Tube Co and Tubular Alloy Steel Corp.

•

A. V. Adamson, for the past 25 years manager of Combustion Engineering Superheater's New York district sales office and one of the pioneers in the development of pulverized coal firing for steam power plants, has retired. He will serve as a consultant to the company. Adamson's early experience was with United Gas Improvement Co, Delaware & Hudson Railroad Co, and Locomotive Pulverized Coal Co. In 1918 he became associated with the first pul-

What does USKON® Electric Heating *mean to* Electric Light and Power Companies?

Uskon is first of all the nearest thing to perfect heat yet devised . . . from the standpoint of human health . . . for its extremely efficient utilization of power services.

THE MOST HEALTHY HEAT EVER PERFECTED

Uskon provides uniform heat from head to foot, primarily warming *objects*, not the air. Floors and walls are always warm, humidity remains constant. The air is more fresh, and colds are fewer. Uskon represents what is unqualifiedly the greatest sanitary and hygienic advance in the history of home heating. To be a prime factor in bringing it to more and more people is a fact of great public relations value to the utilities.

PROVIDES MOST EFFECTIVE USE OF SERVICE LINES

But Uskon approaches the theoretically perfect heat for other reasons too. It heats people and objects. Uskon does not have to count on a large excess capacity to overcome lag and give fast pickup as do convection heat systems. With Uskon, detailed engineering specifications are completed for each home. This careful design means that the utility is assured the most efficient use of its equipment and services.

AVOIDS SEVERE STRAIN ON SECONDARIES

Most electrical heaters marketed today are of the convection type. They labor to heat the *air*, building up sudden heat loads and putting severe strain on the utility system. Uskon always supplies radiant heat—directly balancing the body heat loss. With group installations, Uskon shifts the wintertime peak from the evening to the morning, just when the distribution transformers are in the best position to handle it. And because of Uskon's individual room control, peaks in the load are reduced to the absolute minimum through diversification.

THE PATTERN FOR THE FUTURE

Uskon electric radiant heat, because of its healthfulness, cleanliness, convenience and ease of operation, is destined to play an even larger part in home heating. Uskon is a product of United States Rubber Company and is distributed exclusively by Graybar Electric Company.

Electric heat of the radiant type, like Uskon, reduces peak loads and provides favorable load factors.

We welcome inquiries seeking more complete information about Uskon. One of our sales engineers will supply any facts required. Write Electrical Wire and Cable Department, United States Rubber Company, 1230 Avenue of the Americas, New York 20, N. Y.

Uskon is an electrical radiant heating system utilizing rigid panels placed in the ceiling

USKON USES ELECTRICAL ENERGY ECONOMICALLY BECAUSE:

1. **Effective utilization of radiant waves primarily heats people and objects—not air.**
2. **Rigid engineering specifications of installation and insulation are observed.**
3. **Uskon allows individual room control.**

UNITED STATES RUBBER COMPANY

SERVING THROUGH SCIENCE

Electrical Wire and Cable Department, Rockefeller Center, New York 20, N. Y.

Ask the men who climb 'em!
Ask the men who have to climb the poles how much it means to them to have those poles *clean*—Penta treated. Or ask yourself. Wouldn't you rather work on a clean pole instead of one with an odor that would cling to your clothes? Pentachlorophenol long ago outdated the idea that preservative treatment had to mean sticky poles. Penta Preservative, containing pentachlorophenol, leaves poles clean, yet provides an equal or better protection than other treatments. That's why linemen prefer Penta treatment to any other.
Toxicity of pentachlorophenol to decay and termites is well known. No other commonly used preservative can beat its records. And you're sure with Penta—it is a chemical entity that cannot vary in its make-up (and so its effectiveness) from one time to another.
Treatment with Penta Preservative costs about the same as other preservatives, and will prove an asset in your labor relations. Ask us for any convincing facts or figures you'd like to have. We're ready and eager to give them to you.
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verized coal installation in a central power station, the Oneida Street Station of Milwaukee Electric Railway & Light Co, and later designed pulverized-coal-fired plants in various parts of the country. He joined Combustion Engineering in 1920 as an advisory engineer.

•

Atomic Power Engineers Appointed at Knolls Lab

Rear Admiral Walter S. Macaulay, USN (Ret.) has been appointed assistant executive engineer in the Knolls Atomic Power Laboratory, which is operated by General Electric Co at Schenectady, N. Y., for the Atomic Energy Commission. Lawrence L. Ferguson, who is also assistant executive engineer, will take charge of the West Milton Area Project, where AEC is building an experimental atomic power plant.

Admiral Macaulay will be responsible for general administration in the atomic laboratory. He joined GE in 1948 soon after his retirement from the Navy and has been on the assistant general manager's staff of the Nucleonics Department. Ferguson joined GE's business training course in 1931 and has been at the Knolls laboratory since 1947.

•

G. J. Oglebay, vice-president in charge of operations of Public Service Co of Indiana, has retired after 47 years in the electric utility industry. He joined Public Service in 1910 and has been a serviceman, lineman, and district manager at Monticello, Lebanon, Shelbyville, New Castle, and Bedford. He was operations chief for 22 years. Oglebay also headed rural electrification efforts of the Indiana Electric Association, of which he was president last year.

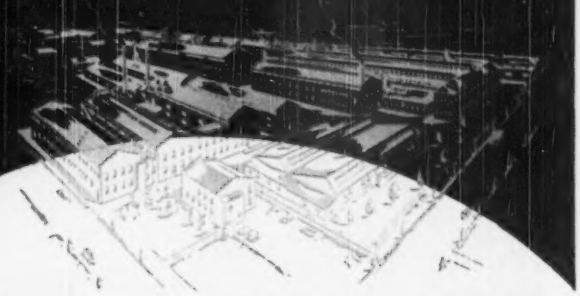
Paul F. Stiller, a former lighting specialist with West Penn Power Co in Pittsburgh, has been appointed manager of the Cleveland office of the Pittsburgh Reflector Co. For the past eight years he has operated a photography studio in Greensburg, Pa.

OBITUARY

Ernest S. Nutting, 68, secretary and treasurer of Hartford (Conn.) Electric Light Co from 1929 until his retirement in 1947, died in Hartford Jan 1. He joined the company in 1899 as a clerk in the accounting department and became assistant treasurer 10 years later. For a time he was secretary to the late A. C. Dunham, founder and first president of the utility.

"EVERYTHING IN CARBON BUT DIAMONDS"

The Stackpole Minute Man—your assurance of prompt, dependable service on molded carbon products.



CARBON SPECIALTIES

As a long time leader in molded carbon, graphite and metal powder specialties, Stackpole offers unsurpassed facilities for designing, engineering and producing almost anything that might be required in this line. The following list indicates something of the range of our facilities in these respects. Information on any type will gladly be sent on request:

RAIL BONDING MOLDS

. . . a typical example of Stackpole molded graphite. Facilitates making permanent rail bonds rapidly and without extensive equipment. A thermite mixture is ignited to melt copper which runs into the mold and forms the bond.

Electrical Contacts
Mercury Arc Rectifier Anodes
Power Tube Anodes
Carbon Pile Voltage Regulator Discs
Battery Carbons
Water Heater Electrodes
Pasteurization Electrodes
Trolley and Pantograph Shoes
Electric Furnace Elements
Resistance Brazing Tips
Welding Carbons
Seal Rings
Bearing Materials
Clutch Rings
Friction Segments
Graphite Anodes
Carbon Molds & Dies
Continuous Casting Dies
Rail Bonding Molds
Brazing Furnace Boats
Dash Pot Plungers

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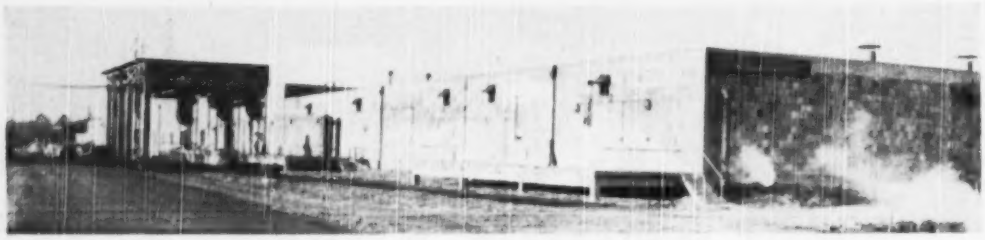
MANUFACTURERS and MARKETS



NEW PLANT of Larkin Electro Products Corp, Pine Bluff, Ark., will house the manufacturing facilities of the Larkin Transformer Division. The company plans to increase its production facilities in power and distribution transformers up to 10,000 kva, 69,000 v

British Bids Referred to Seattle City Council

City Light of Seattle has referred to the City Council all bids it received recently for transformers to be installed in the powerhouse it will build at Ross Dam on the Skagit River for operation in 1952.

The reference was made because the two low bids came from English firms and a contract award to a firm outside the United States would establish a policy City Light believes should be established only by the Council.

The city charter provides that the purchasing agent, in deciding "lowest and best bidders," shall give preference to bidders who supply material produced within the state, on condition such bids do not exceed the "lowest bid" by more than 5%. It contains no specific mention of preference for American goods as against foreign-made products, however.

Agents of the English firms, in urging acceptance of their bids, pointed out that British Overseas Airways Corp has bought a number of Stratocruisers from Seattle's Boeing Airplane Co for $1.5 million.

•

Parts Center Established

Westinghouse Electric Corp has established a renewal parts center at Newark, Ohio. More than 3 million parts for Westinghouse refrigerators, ranges, water heaters, Laundromats, and other appliances have been moved from the Mansfield Plant. The center can handle over 2,500 orders a day, the company reported.

MANUFACTURING BRIEFS

Stockholders of Moe Brothers Manufacturing Co, Fort Atkinson, Wis., have voted to change the corporate name to Moe Light Inc. The shift is being made to tie the firm in more directly with its brand name for residential and commercial lighting fixtures, Moe Light.

The Norge Division of Borg-Warner Corp, Chicago, will move its general office from Detroit to the Merchandise Mart, Chicago, during the next few months. Norge will occupy approximately 35,000 sq ft of space on the second floor of the building. No Norge products have been manufactured in Detroit since before the war.

Two new plants of Aluminum Co of America will begin production early this year. Output will start soon at the new aluminum-producing plant in Point Comfort on the Gulf coast of Texas. This unit was largely completed last year. In early spring operations are scheduled at Alcoa's new wire, rod, and electrical cable mill at Vancouver, Wash.

Kaiser Aluminum & Chemical Corp, formerly Permanente Metals Corp, produced more than 250 million lb of primary aluminum in 1949. Increased production was made possible by acquisition of more power from Pacific Northwest sources.

Moorhead Electrical Machinery Co has moved its offices from Pittsburgh to its Oakdale, Pa., plant.

Reynolds Aluminum Will Buy 5 Plants from U. S.

Reynolds Aluminum Co will buy five war-built aluminum plants from the government. Reynolds has been operating the plants under lease. Original cost to the government was $130 million. The sale price will be $50,081,958. Part of the payment will be in cash, the remainder in aluminum which will go on the government stockpile. Under its lease Reynolds has been paying rent in aluminum.

The General Services Administration, which is liquidating the government's remaining war plants, said Reynolds would be required to make a down payment of 5% and to pay off the remainder in 25 years at 4%.

The properties are an alumina plant and sinter plant at Hurricane Creek, Ark.; reduction plants at Jones Mills, Ark., and Troutdale, Ore.; a sheet and rolling mill at McCook, Ill.

•

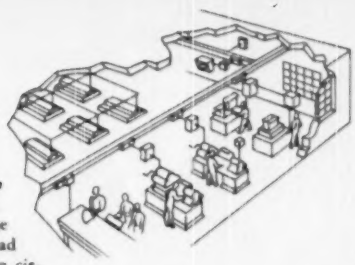
Honeywell Creates Post, Shifts Field Managers

A new management sales post has been created and four branch and regional managers promoted by Minneapolis-Honeywell Regulator Co.

Fred Kaiser, Midwest regional manager since 1942, has been given the new post of field sales manager. He will coordinate the activities of the 77-branch field organization.

Clarence L. Peterson, who has been Pacific regional manager for Honeywell with headquarters in San Francisco, will succeed Kaiser in the Midwest area.

How KUHLMAN puts power where you need it



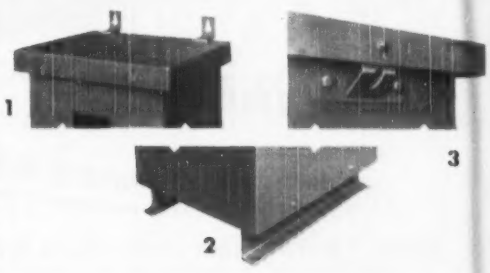
Kuhlman Dry Type Transformers deliver high voltage right to your load centers. Lighting circuits, machine tools, and other electrical equipment are most efficiently served by locating transformers near at hand. This eliminates costly long runs of heavy copper, reduces operation losses and improves voltage regulation.

Kuhlman Dry Types are air-cooled, require no fireproof vaults, and reduce fire and explosion hazard to a minimum. Available in either wall or floor mounted units, 1 through 300 KVA, single phase and 3 through 1500 KVA, three phase.

Easy installation, easy handling! Kuhlman Dry Type Transformers are equipped with convenient wall mounting brackets for bolting to wall or beam.

Floor mounted types come equipped with drilled channels for easy bolting to floor or platform surface.

Easy handling is assured by handy lifting lugs that make moving of Kuhlman Dry Types a simple matter.



Less weight, better performance are assured with the Kuhlman Bent Iron Core. Used in single phase units 25 KVA and below, the Bent Iron Core is made of high grade oriented cold rolled steel. This steel provides greater flux carrying capacity, resulting in a lighter core, lower exciting current and impedance, better regulation and performance. This all means a smaller, lighter, more efficient transformer for you.

A few turns of a wrench removes the louver panel or cover for quick accessibility to roomy terminal compartment. Handy conduit knockouts make the connection job an easy one. Result — few installation and maintenance worries when you buy Kuhlman dry types.

Get further information on Kuhlman Dry Type Transformers. Write for Bulletin CS 701 just off the press. Kuhlman also manufactures a complete line of Power, Distribution, Street Lighting, and Specialty Transformers. Bulletins available upon request.

EXPERIENCE COUNTS — THIS IS OUR 56TH YEAR

Kuhlman

KUHLMAN ELECTRIC COMPANY
BAY CITY, MICHIGAN

Export Representatives: *International Standard Electric Corporation*, 67 Broad St., New York City, N.Y. Cable Address: Microphone, N.Y.

was this call necessary?

Some "Moral Insurance" here might have avoided a serious accident

Workmen's compensation is a fine thing—but it can't replace a mangled arm.

Safety laws prevent many accidents—but they can't cover every hazard of an individual plant.

Accident prevention which goes *beyond the law* is an unwritten responsibility of every employer. It is his "Moral Insurance" for his employees welfare.

The premiums for "Moral Insurance" are not high. They do not have to be paid for in fancy safety gadgets. Their cost is simply the institution of common sense safety regulations covering all local hazards—enforced by employee committees with the full support of management.

Yes—"plant safety" is a mutual job.

DON'T FORGET—THE LIFE YOU SAVE MAY BE YOUR OWN

Published in the public interest by:

McGRAW-HILL PUBLICATIONS

Peterson's place will be taken by Gavin S. Younkin, Los Angeles branch manager since 1943. Reginald C. Cushing has been promoted to branch manager of the San Francisco office, where he has been regional air conditioning sales manager.

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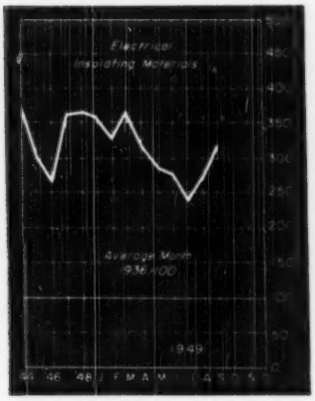
Insulating Material Sales Up Again in September

Insulating material sales continued to climb in September. The index of sales billed on electrical insulating ma-



terials, compiled by the National Electrical Manufacturers Association, stood at 318 for that month, a 16% increase over the 273 recorded for August.

September, 1949, sales were 18% below the same period of 1948. Then the index was at 387.

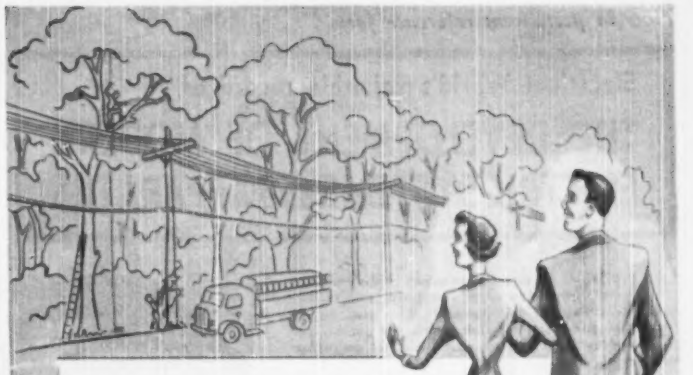
•

New Sales Assignments

Electrical manufacturing companies have announced the following appointments to their sales staffs:

Fairbanks, Morse & Co. Chicago, has made several changes in its sales organization. J. A. Cuneo, formerly Los Angeles branch manager, has been made Chicago branch manager. A. M. McLaren succeeds him in Los Angeles. John S. King, formerly Chicago manager, has been moved to Cincinnati as manager there. He succeeds J. S. Peterson, transferred to the sales manager's office in Chicago. William H. Kingsley, for the past 12 years district manager of the New York office of Ideal Electric & Manufacturing Co, has joined Fairbanks-Morse as manager of the electrical division, with headquarters in Chicago.

Edwin F. Guth Co. St. Louis, has named two new sales representatives. Frank Moos, with an office in Washington, D. C., will cover the Maryland, Virginia, and District of Columbia area. Rene M. Moisson, 71 Prentiss St, Cambridge, Mass., will represent the company in the six New England states.



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when BARTLETT clears your lines

EVERYBODY likes the Bartlett Tree Man . . . friendly, cooperative, and obviously skilled at his job; your customers will like the neatness and efficiency of Bartlett work, performed with a minimum of disturbance to their property and everyday life. Bartlett on the job is your assurance of more friendly public relations.

YOU receive plus value when you retain Bartlett for line clearance; contact our local office in your community or write direct to the home office; our nearest representative will call promptly.

BARTLETT SERVICE MEANS

- TRAINED MEN
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BARTLETT TREE EXPERTS

The Bartlett Way

HOME OFFICE: RESEARCH LABORATORIES & EXPERIMENTAL GROUNDS, STAMFORD, CONN.

LOCAL OFFICES: Rutland, Windsor, Vt.; Milford, Petersboro, Rochester, N. H.; Cambridge, Framingham, Manchester, Osterville, Pittsfield, Mass.; Providence, R. I.; Danbury, Hartford, New Canaan, New Haven, Stamford, Westport, Conn.; Ithaca, Kingston, Monroe, Middletown, New York, Peekskill, Southampton, Syracuse, Westbury, White Plains, N. Y.; Bernardsville, Morristown, Orange, N. J.; Chambersburg, Paoli, Philadelphia (Cynwyd), York, Pa.; Wilmington, Del.; Bethesda, Easton, Towson, Md.; Ashland, Ky.; Lancaster, Portsmouth, Ohio; Charlottesville, Lynchburg, Roanoke, Va.; Bluefield, Charleston, Huntington, W. Va.; Kingsport, Tenn.

Now in permanent reference form . . .

Electrical World's valuable record of

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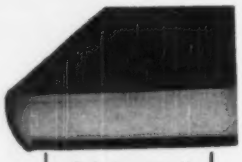
Designed for easy reading, this book brings you in compact form the unique record of the developesent of hydro- and turbo-electric power plants—of techniques for the construction, operation and maintenance of the far-flung systems—of public regulation over companies, their rates and their profits—of the spasmodic movements for federal and municipal ownership of electric utilities—and of the rise of industry organizations.



Reflects extensive research in the electrical power field, and is composed wholly of material as presented in the pages of *Electrical World*.

THE ELECTRIC POWER INDUSTRY

PAST, PRESENT and FUTURE

Compiled by the Editors of *Electrical World*

178 pages, 8½ x 11, illustrated, $3.50

Discusses—

- Power systems
- Power stations
- Station generation
- Transmission
- General system techniques
- Distribution
- Maintenance and metering
- Use of electricity
- Organization and regulation
- Industry organizations

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Every major phase of electric power development is covered—generating equipment, transmission lines, protective relaying, substation design, power metering, rural electrification, holding companies, state regulation, N.E.M.A., Edison Electric Institute, National Electrical Wholesalers Association, etc., etc.

The Electric Power Industry is truly a landmark along the road of free enterprise and scientific progress. It belongs in the library of every electrical man, those just entering the field, and students of this and related industries.

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NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Alabama—Coosa Valley Electric Co-operative, Talledga, 13.2 mi. rural distr. lines and 2 substations in St. Clair, Shelby and Talladega Counties. Plans deposit $10. Patterson & Dewar, Rutland Bldg., Decatur, Ga., engrs.

Arizona—Bureau Reclamation Dpt. Interior, Phoenix, control board and control panel for Gila substation, Gila Proj., Spec. R3-PX-26 Region 3). L. N. McClellan, Bldg. 1-A, Denver Federal Center, Denver, Colo., ch. engr.

Arizona—Bureau Reclamation Dpt. Interior, Phoenix, bus structure for Prescott substation Davis Dam Proj., Spec. R3-PX-31, (Region 3). L. N. McClellan, Bldg. 7-A, Denver Federal Center, Denver, Colo., ch., engr.

Kan., Leavenworth—B.A. 1/11—Pub. Bldgs., Admin., Federal Wks. Bldg., F St. between 18 and 19 Sts. N. W., power plant at Federal Penitentiary.

Kentucky—South Kentucky Rural Electric Co-operative Corp., Somerset, 194 mi. rural distr. lines, sys. imprvs., Wayne Co. **$900,000.**

Michigan—Northern Michigan Electric Co-operative, Boyne City, two 7500 kw steam units and one 100 kw diesel unit, 106 mi. 115 kv line and 229 mi. 44 kv line plus substation, Cheboygan Co., **$6,661,000.**

Michigan—Top-O'Michigan Rural Electric Co-operative, Boyne City, 217 mi. rural distr. line and sys. imprvs., Charlevoix Co. **$780,000.**

Minnesota—Wild Rice Electric Co-operative, Mahnomen, 254 mi. rural distr. lines sys. imprvs., Becker Co. **$400,000.**

Montana—U. S. Eng., Fort Peck Dist., Fort Peck, installing third generating unit (35,000-kw) with associated equipment, appurtenances, at Fort Peck Power House near east end of Fort Peck Dam, Missouri River approx. 20 mi. southeast of Glasgow, CIVENG 24-016-50-36.

Montana—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., Miles City substation, Spec. R6-36 (Region 6), Fort Peck Proj. L. N. McClellan, c/o owner, ch. engr.

Nebraska—Bureau Reclamation, Dpt. Interior, Casper, Wyo., furnishing, del. one bus structure relay board, battery charger for Sidney Substation, Transmission Div., Missouri River Basin Proj., Spec. VII-94.

Nebraska—Eastern Nebraska Public Power Dist., R. C. Johnson, pres., Syracuse, 5 separate substations to stepdown from 69 kv to 7.2/12.47 kv. near Nehawka, Humboldt, Brock, Cook and Verdon. Henningson Eng. Co., 626 Standard Oil Bldg., Omaha, Zone 2, engr.

Neb., Stromburg—Polk County Rural Public Power Dist., Stromsburg, service and shop bldg. with offices in connection for rural distr. sys. $74,000. James Loftus, Omaha Natl. Bank Bldg., Omaha, archt.

N. Y., Brooklyn—Bd. Transportation, 250 Hudson St., New York, Zone 13, installing telephone cable to and associated work in the Transportation Bldg., Jay and Willoughby Sts.

N. Y., Brooklyn—Bd. Transportation, 250 Hudson St., New York, Zone 13, Contr. UG, circuit breaker house at Livonia Ave. and Warwick St.

Texas—Hall County Electric Co-operative, Memphis, 2 way communication sys., expanded lines, headquarters facilities, Hall Co. **$158,000.**

Utah—Escalante Valley Electric Assoc., Beryl, 95 mi. rural distr. lines and sys. imprvs., Iron Co. **$586,000.**

Washington—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Odair, Wash., transformers, resistors for Grand Coulee Power Plant, Columbia Basin Proj., Spec. 2878. L. N. McClellan, ch. engr.

Wyoming—Bureau Reclamation, Dpt., Interior, Casper, Wyo., steel structures for Sidney substation, Transmission division

Missouri River Basin Proj., Spec. R7-102 (Region 7), L. N. McClellan, Bldg. 1-A, Denver Federal Center, Denver, Colo., ch. engr.

Low Bidders & Contracts Awarded

Ill., Deerfield—H-D Electric Co., Osterman Ave. and Soo Line R.R., 80x140 ft., brick, concrete factory, to Camm Constr. Co., Wheeling, **$68,000.** Awarded 12/15. Krol & Hastrup, 542 S. Dearborn St., Chicago, Zone 5, engrs.

Ill., Pontiac—State, Springfield, Dec. 26, power house at Pontiac branch, Illinois State Penitentiary, from R. V. Menaham Constr. Co., 1951 W. Irving Park Blvd., Chicago, **$305,825.**

Montana, Billings—Montana Power Co., Billings, design and construction steam electric plant incl. 66,000 kw. electric generating station, semi-outdoor type unit, stack 250 ft. high, boiler, steam electric turbo generator, to Ebasco Services, Inc., 2 Rector St., New York, N. Y., Approx. **$200,00c.**

N. Y., Thiells—Bureau Contracts & Accounts, Albany, Dec. 21, general contract power house addn. Letchworth Village, from Geico Builders, 180 E. 123 St., New York, **$176,483;** heating, from The Interboro Co., 235 E. 34 St., New York, **$527,000.**

North Dakota—Slope Electric Co-operative, New England, 20 mi. high voltage transmission lines and 563 mi. rural distr. lines, Adams, Bowman, Hettinger and Slope Counties, to Line Builders, Inc., Northern Pacific Industrial Site, Billings, Mont., **$337,437.** Bids 10/18.

O., Cincinnati—Ford Motor Co., 300 Schaefer St., Dearborn, Mich., 1 and 2 story, no bsmnt., 520x800 ft., brick factory, office bldg., power plant, incl. parking area, railroad siding, on approx. 58 acres to Darin & Armstrong, 2041 Fenkel Ave., Detroit, Mich., Approx. **$3,000,000.**

O., Willard—Bd. Pub. Affairs, Willard, 60x90 ft. municipal light plant addns. housing 2,500 kw. generator, to Roth Bros., Norwalk. Approx. **$120,000.**

Oregon—Bonneville Power Admin., Box 3537, Portland, Zone 8, Dec. 22, clearing right-of-way for McKinley-Bandon 115 kv transmission line, Inv. 4902, Coos Co., from Peterson Egg Co., 41-26, 26 St., San Francisco, Calif., **$88,350.**

Tex., Dallas—Liberty Broadcasting System, c/o KLIF Station, B. B. McLendon, Towers Hotel, 11 story, bsmnt., radio broadcasting and office, Puchase and Hire. Approx. **$1,000,000.**

Tex., Hearne—City, Dec. 16, municipal electric power plant, diesel engine unit, from The National Supply Co., Magnolia Bldg., Dallas, **$90,850.**

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Ark., Little Rock — University of Arkansas, Medical School, MacArthur Park, Little Rock, plans by Erhart, Eichenbaum & Rauch, Wallace Bldg., medical center, **$6,200,000.**

D. C., Wash.—National Capitol Sesquicentennial Comm., District Bldg., plans by Bryne Organization, 2607 Connecticut Ave. N. W., Freedom Fair, incl. Federal Bldg., Hall of States, Industry-Labor Group, Pan American Center, United Nations Bldg., recreation area, in Anacostia Park at East Capitol St. and Anacostia Ave. and Memorial Amphitheatre (permanent construction) in Rock Creek Park, **$15-000,000.**

Ga., Atlanta—Long Corp., King and Mount Pleasant Sts., Charleston, S. C., plans by William G. Lyles, Bissett, Carlisle & Wolff, 1302 Main St., Columbia, S. C., apartment. **$5,000,000.**

Mich., Detroit—Pub. Bldgs. Admin., 18 and F Sts. N. W., Wash. 25, D. C., Marine Hospital addn., 14639 Riverside Dr. **$11,-500,000.**

Low Bidders & Contracts Awarded

Pa., Phila.—Veterans Admin., Vermont Ave. between H and I Sts. N. W., Wash. 25, D. C., general contract Veterans Hospital, Spec. 4925, to John McShain, Inc., 17 and Spring Garden Sts., **$6,527,200.** Bids 12/13, Awarded 12/21.

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Television Interference Seldom Comes from Power System

(Continued from page 59)

standard paper condensers (0.01-0.25 μf) may be connected from the terminals of the offending device to frame or ground. This remedy is only partially effective with heating device thermostats. A 100% cure for direct radiation is impossible without shielding, which would be rather impractical in these cases. Since the area of interference from many domestic appliances is so confined, most people feel they can put up with the interference from such sources during the short intervals while the household equipment is being used.

IX Power-Line Interference

Tests made so far indicate little or no interference from our power lines under normal operating conditions even with the video antenna only 20 to 30 ft from these energized circuits. A usable to very good picture was received in all cases with the broadcasting station about 45 miles away and with a 50-300 mv signal input to the television receivers; results depended on location and elevation of receiving area with respect to the video broadcasting station. These results were obtained outside the primary broadcasting range, namely 500 mv per meter contour.

Television receivers are not necessarily influenced by conditions which might interfere with the standard AM sound broadcast band; the latter may be disturbed by very old 13 to 33-kv lines on old-type pin insulators and by some early 66-kv lines. However, very few television complaints have been traced to such lines.

During the last 18 months, only a dozen out of many cases of interference have been traced to power lines. One case was traced to a cracked 4-kv insulator which did not interfere whatsoever with the broadcast band. The interference was felt only 1/10 mile from the source. The effect on the video screen looked exactly like that caused by ignition, except that it was continuous. Replacement of the defective insulator completely eliminated the trouble.

One defective lightning arrester and static discharges from some types of line hardware were other causes.

Tests made directly under our oldest 132-kv circuit, with the television antenna about 20 ft from the bottom phase, showed good reception except under heavy rain and snow conditions. Even then, very good television pictures were received when the receiver was moved only 150 ft from the line. Further tests are now being conducted in close proximity to the 500,000-v full-scale experimental lines of the American Gas & Electric system near Tidd Plant.

• • •

Port Jefferson Station Features Save on First Cost

(Continued from page 66)

bined with contrasting chocolate brown brick panels and limestone trim, have been used for the main power plant building and for the miscellaneous outlying structures.

To make the exterior portions of the boiler less obvious the steelwork, ducts, piping and other elements have been painted to blend with the gray face brick of the main building.

Main turbine room is illuminated by twin units, each comprised of one 400-w mercury lamp and one 1,000-w incandescent light. Emergency lighting is provided in strategic sections of the plant by means of incandescent fixtures connected to the station battery as well as to the normal lighting panels.

Control room lighting consists of fluorescent lamps mounted above a white, egg-crate louvered ceiling.

Fuel Handling System

Fuel for the plant is water borne, because the plant area has no railroad siding. Oil is pumped from barges to an 80,000 bbl storage tank on a hill (el 100 ft) near the main building. For burner services the flow is directly from the storage tank to the fuel oil pumps and thence to the burners. Oil has been used since the plant started in operation.

An extensive coal handling system is being installed. A storage area has been provided for 66,000 tons of coal and a 1,800-ton active pile.

The coal handling facilities will present an appearance in keeping with the general architectural treatment of the main building, and the design will emphasize cleanliness. To this end the coal unloading tower, to be located on the reinforced concrete dock, will be enclosed with cement asbestos board having the corrugations running vertically, the steeple will utilize steel plate fabricated to present a streamlined appearance, and the bucket and hoppers will be made as dust-tight as possible.

All the exterior portions of the coal conveyor galleries also will be cement asbestos board enclosed, with the corrugations running horizontally, and will be provided with precast concrete floor slabs. Among the precautions taken to control the coal dust will be the maintenance of a slight vacuum in the steel plate bunkers, these bunkers to be filled from a sealed-type tripper.

Dust Collectors

The management has insisted that atmospheric pollution be avoided insofar as possible. Accordingly, dual dust collectors have been installed. The gases leaving the steam generator first pass through a mechanical dust collector and then through an electrostatic precipitator before being discharged through the two induced draft fans into the chimney. This 300-ft high radial brick chimney has been designed to handle two boilers.

Fly ash collection efficiency is calculated to be approximately 99%. Both ash and fly ash are carried by means of a pneumatic system to a vitrified lined bin for disposal.

Engineering and design and the construction supervision of the first 40,000-kw unit installation were performed by Ebasco Services Inc, under the direction of the Long Island Lighting Co's Messrs E. W. Doebler, vice president and general operating manager, and S. E. Bowler, electric operating and engineering manager.

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RECENT RATE CHANGES

Vallejo Electric Light & Power Co rate decreases totaling $40,000 annually have been approved by California Public Utilities Commission. Domestic and commercial customers will save about 5% and industrial users about 4%.

Brockton (Mass.) Edison Co reduced residential rates Jan 1 by $35,000 a year and commercial rates by $22,000 because of savings in fuel costs and increased use of home appliances. Industrial customers with fuel clauses in their contracts automatically benefit.

Manitoba Power Commission has reduced by 25¢ the minimum monthly electric bill for domestic consumers in 122 Manitoba towns and villages. The cut was in line with the Commission's policy of reducing the domestic minimum annually for new towns until the standard minimum is reached.

Gallup (N. M.) Electric Power Dement has announced cuts of from 20 to to 33% in domestic and commercial power rates effective Jan. 1. The lower rates, urged by local appliance dealers, are intended to encourage greater consumption of power.

Cowlitz Public Utility District. Longview, Wash., has extended the Longview residential rate to the remainder of Cowlitz County and removed the 5% state generation tax from power bills. The adjustment means slightly lower bills for residential customers in the county.

Cedar Point (Ill.) Light & Water Co has been authorized to reduce its electric rates in Cedar Point by 15%. The reduction will save its customers $1,400 a year.

Ontario Hydro-Electric Commission has raised its rates to Niagara Falls Hydro Commission by 25% and has announced there will be no rebate this year. Rates were hiked similarly in adiacent Stamford township. A 10% general increase for Ontario has been announced.

Shawinigan Water & Power Co's request for permission to up rates for domestic and commercial power services has been granted "in part" by the Quebec Provincial Electricity Board. The increases, applied in varying amounts to domestic, commercial, and small power users, are estimated to total about $500,000 annually and represent an average boost of about 6%.

Empire District Electric Co's proposed rate schedule for Springfield, Mo., has been suspended by Federal Power Commission pending hearing and decision. Hearing has been set for Feb 27. FPC said the proposed schedule would result in an increase of more than $60,000, or 18.7%, in the company's annual charges.

Florida Power Corp's rate increase, in DeLand, requested 10 months ago and later put into effect without city approval, finally has been okayed by the City Commission. The 6 to 8½% jump in rates is designed to produce $2,200 additional revenue monthly.

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If PRE-FILED ELECTRICAL CATALOGS is not available for buying reference at your plant, write to McGRAW-HILL CATALOG SERVICE, 330 West 42nd Street, New York 18, N. Y. There is no charge to qualified users.

CATALOGS • BULLETINS

● RELAYS: Relay Catalog No. 14 is a guide to selection of relays, thermo-regulators, temperature controls, and selector switches. H-B Instrument Co, 2633 Trenton Ave, Philadelphia, Pa.

● BATTERY CHARGING: Plugs and receptacles for charging truck storage batteries and for use as connectors for portable electrical apparatus are listed in Catalog 50B. Albert & J. M. Anderson Mfg Co, 289 A St, Boston 10, Mass.

● CABLE FITTINGS: Multiple cable fittings, terminal lugs, strain connectors and suspension clamps are covered in Publication 4211-A. Delta-Star Electric Co, 2400 Block Fulton St, Chicago 12, Ill.

● MOTORS & GENERATORS: Six new bulletins cover induction motors (No. 100), synchronous motors (No. 502), synchronous motor control (No. 671), high-speed motors (No. 500), low-speed alternators (No. 510) and induction motors to 3,000 hp (No. 501). Ideal Electric and Mfg Co, Mansfield, Ohio.

● FUSES: Brief descriptions of fuses, fuse clips, fuse pullers, and oilers appear in a folder, Series F-L-B 300A. Trico Fuse Mfg Co, Milwaukee, Wis.

● SWITCHES: Catalog No. 1343 presents engineering and selection data on mercury switches. Minneapolis-Honeywell Regulator Co, Brown Instrument Div, Wayne and Roberts Aves, Philadelphia 44, Pa.

● SUBSTATIONS: Ways to landscape unit substations, with photographs of typical urban installations, appear in Bulletin GEA-5155. General Electric Co, Apparatus Dept, Schenectady 5, N. Y.

● PAINTS: Technical properties and uses of anti-corrosive paints are presented in a new catalog. Subox and Subalox, Fairmount Plant, Hackensack, N. J.

● COAL HANDLING: Fourteen case histories of coal handling and storage systems and how they may be adapted to varying conditions are described in Bulletin 300. Gifford-Wood Co, Hudson, N. Y.

● LIGHTING: Lenox-2 fixtures, and Day-Line industrial fixtures are covered, respectively, in bulletins 10-E-1 and 30-A-3. Day-Brite Lighting, Inc, 5411 Bulwer Ave, St. Louis 7, Mo.

● WELDING: Descriptions, specifications, and prices of more than 150 arc-welding accessories are contained in a 20-page catalog, GEC-253A. General Electric Co, Schenectady 5, N. Y.

● MOTOR MECHANISMS: Publication 4600-A presents information on motor mechanisms for group operated switches. Delta-Star Electric Co, 2400 Block Fulton St, Chicago 12, Ill.

● HEATING: Practical information about types of heating units and how they can be applied to specific farm operations is contained in booklet B-4156. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

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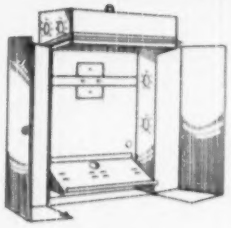

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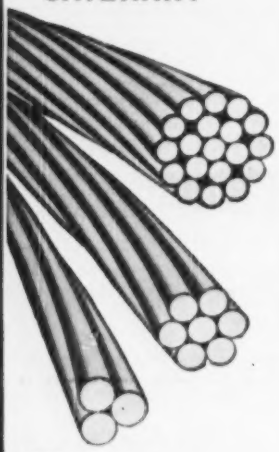

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TECHNICAL LITERATURE

Screw Threads—*Unified and American Screw Threads for Screws, Bolts, Nuts and Other Threaded Parts* is now an American Standard. It contains tables for the limits of size for all standard threads and certain selected diameter-pitch combinations of special threads based on nine pitches of engagement. In addition there are tolerance step tables. The fact that the new tolerances are now formula-based makes it possible for any thread to be made in any of the English-speaking countries to interchange with a mating thread made in any other. The publication, known as American Standard B-1.1-1949, has been issued by American Society of Mechanical Engineers, 29 W. 39th St, New York 18, N. Y., at $3 each.

Glass Yarns—*NEMA Standards for Continuous-Filament Glass Yarns* covers glass yarns used in the covering of wires and cables and in the production of electrical insulating materials. Information is provided concerning composition, physical properties, nomenclature and testing. Publication GF1-1949, 12 pages, priced at 70¢, is available from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y.

Distribution Cutouts—Information on rating, performance, application, and manufacturing is contained in *NEMA Standards for Distribution Cutouts, Power Fuses and Current-Limiting Resistors*, Publication No. 49-145. Now undergoing revision, the section on distribution cutouts will be printed as a supplement and will be available without cost to all purchasers of these standards. Terms used throughout the standard are defined and a section is devoted to instructions for the installation, operation, and care of distribution cutouts and power fuses. It is obtainable for $1.60 from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y.

Vulcanized Fibre—*NEMA Recommended Practice for Fabricating Vulcanized Fibre*, Publication VU2-1949, contains limitations and detailed recommendations. Engineering information covering the following machining operations is included: cutting, punching, shaving, broaching, drilling, threading, tapping, milling, shaping, sanding, marking, finishing and screw machine and lathe operation. Sixteen pages, costing $1.25, the standards can be ordered from National Electrical Manufacturers Association, 155 E. 44th St, New York 17, N. Y.

Hydraulic Turbines—*Prevention of Cavitation and Pitting in Hydraulic Turbines* is the subject of a 12-page bulletin elaborating upon applicable basic formulas and the relative economic merits of avoiding cavitation or minimizing its effects. Several examples of pitting, the destructive effect of cavitation, are shown, and the mechanisms of cavitation and pitting are explained. Resistance of various special metals to pitting is given and methods of utilizing these metals at critical points to withstand pitting are discussed. Copies of Bulletin 02B7226 may be had from Allis-Chalmers Mfg Co. S. 70th St, Milwaukee, Wis.

Overcurrent Protection—Low-voltage circuits of 30 amp or less used for interior wiring are covered in some detail in *Branch Circuit Overcurrent Protection*, a report of a joint EEI-AEIC committee. Many graphs and tables appear in the report which has sections on fires related to wiring, trends in residential branch circuit loadings, ratings, and demand curves, overcurrent protective devices, economics of branch circuit design, and related topics. Publication No. R-9, is

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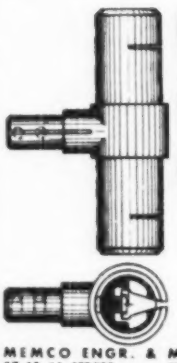

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obtainable at $1 from the Association of Edison Illuminating Companies, 40 W. 40th St, New York, N. Y., and Edison Electric Institute, 420 Lexington Ave, New York, N. Y.

Commercial Glasses—A compilation of electrical data on electrical glasses, and similar information about glasses used for general purpose and chemical applications, appears in Bulletin B-83, *Properties of Selected Commercial Glasses*. Electrical properties covered are dielectric strength, volume resistivity, surface resistivity, power factor, and dielectric constant. Many graphs and a general table of properties (28 glass codes) are also included. Bulletin is obtainable from Corning Glass Works, Corning, N. Y.

Boilers—*Boilers and Combustion, 1948* is a report by the Boilers and Combustion Subcommittee of the Prime Movers Committee, Edison Electric Institute. Many boiler and combustion problems of operating companies are discussed and included are manufacturers' statements on boilers, superheaters, furnace and air heaters, ash, dust, and cleaning equipment, control equipment, and other topics. This Publication R-1, containing 49 pages and 72 illustrations, is priced at $1.00 to members by Edison Electric Institute, 420 Lexington Ave, New York 17, N. Y.

Power Fuses—Sixty pages of curve sheets and engineering notes, visibly filed in separate, indexed folders for each fuse line, comprise the *Power Fuse Time-Current Characteristic Curves* for use in fuse application and coordination. Information includes total clearing time, minimum melting time, short time rating curves, and effects of "pre-loading" and ambient temperature changes on melting time characteristics. Standard, slow, and time-lag characteristics are also found in this publication of S & C Electric Co, 4421 Ravenswood Ave, Chicago 40, Ill.

Commutators—Methods and procedures described in *Commutator and Slip Ring Maintenance* are said to be based upon the most conclusive evidence now available to unbiased authorities. The 33-page handbook has sections on trouble corrections, brushes, general maintenance procedure, company's products and an appendix of terms. It is obtainable from Ideal Industries Inc, Sycamore, Ill.

Handbook—A new edition of the *DeLaval Engineering Handbook* has just been issued by the DeLaval Steam Turbine Company, edited by A. H. Church and Hans Gartmann. The 300 pages are devoted to tabular and graphic data for the selection and application of steam turbines, centrifugal pumps, Imo pumps, centrifugal compressors, helical and worm reduction gears. Tables also give pipe friction and head loss along with mathematical and unit conversion data. Advertising is confined to the final 20 pages. Copies may be obtained at $2 from the company's advertising department at Trenton 2, N. J.

Varnished Insulations—*The V. I. Story, Varnished Insulations in Electrical Engineering* was written as a reference book by David O. Woodbury from material secured from the major V. I. manufacturers. Topics covered include the nature and purpose of varnished insulations, their origin and development, and their use in rotating apparatus, transformers, cables, power distribution systems, motor controllers, high-tension magnetos, and electronic equipment. Book is available for $1 from the Varnished Fabric and Paper Section, National Electrical Manufacturers Association, 115 E. 44th St, New York 17, N. Y.

Coal and Oil—*Ohio Coal and Oil Studies* covers investigation of the washability of several Ohio coals and a survey of production of the Corning, Ohio, oil pool. Priced at 75¢, the bulletin is No. 138, issued by Engineering Experiment Station, The Ohio State University, Columbus, Ohio.

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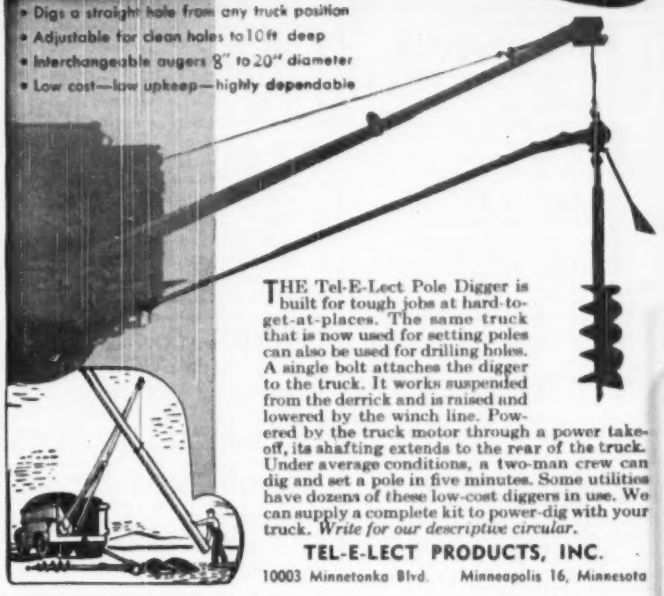

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LETTERS TO THE EDITOR

No Change in Sub-Metering

To the Editor of ELECTRICAL WORLD:

The item in the November 5th issue of ELECTRICAL WORLD on Page 60, relating to the Boston Edison Company's re-sale rate case states "However, it forbade extension of the re-sale practice".

It would be more accurate to state that the Department of Public Utilities made no change in the existing regulations under which the Boston Edison Co refuses to extend sub-metering. This is in accord with the provisions of M.D.P.U. 54 which is the rate schedule that has been in effect in this area for some time prior to the case in question. There is no statement in the opinion of the Department in case D.P.U. 8228 that justifies your statement and it is only referred to by Mr. Gadsby in his supplemental letter where he states as follows: "The disposition of this matter ordered by the majority seems clearly to me to place the parties in a most unsatisfactory technical situation, since it would leave the provisions of M.D.P.U. 54 still in effect, which allow resale as it existed at the time of filing, but prevent further extension of the practice."

Carroll H. Shaw
Consulting Engineer
New York

Our-Slip-Is-Showing

To the Editor of ELECTRICAL WORLD:

A little while ago I was looking over the October 29th news issue of Electrical World and read with interest the double page spread on pages 16 and 17 "Back to the Farm."

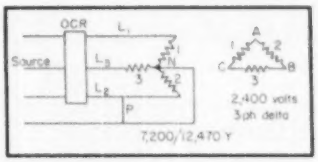
I was rather amused at the picture showing the kerosene lamps with the caption ". . . the Fredericks will have adequate and correct lighting in every room." Imagine—with one 100-watt electric lamp!

Roy A. Palmer
Duke Power Co
Charlotte, N. C.

Peculiar Pecos Problem

To the Editor of ELECTRICAL WORLD

Consider the three-phase bank of transformers (diagramed) 7200/12450 Y to 2400 delta with an oil circuit recloser of the three phase type at OCR. Suppose a single phase temporary fault, such as a flash-over, occurs from L_3 to N as at P. For purposes of this discussion, P may be any place between OCR and the transformers. The recloser in line 2 will open momentarily, supposedly to extinguish the arc. But the transformer primaries 1 and 3 will still be energized from L_1-N and L_2-N, thus inducing full voltage in secondaries 1 and 3. This will produce full secondary voltage across points A-B, as in an open delta, and transformer 2 will have full voltage on both secondary and primary and will feed energy into the fault at P, thus maintaining the arc.



The recloser in Line 2, will go merrily through its three or four operations to lockout, at which time all three lines will be opened and the arc will be extinguished along with all the lights. Consider the lineman's disposition when he has to drive twelve miles on a stormy night to reclose it manually!

Sure, sure, if the fault current is great enough, the first tripout may kick one of the other phases at OCR, say L_1, but transformer 1 will still have full voltage across L_1-N, and secondaries 2 and 3 will be in series across points AC, so primaries 2 and 3 will each have half voltage and the fault at P will drop to half voltage, which may or may not extinguish the arc.

The foregoing is not idle speculation. We fought this situation through this past summer's lightning season, the worst in many years. Please won't someone be good enough to build an oil circuit recloser which will trip all three lines whenever one phase coil operates, and trip them every time!

If any company has such a critter on the market now, please come a-running. We know where you can sell some.

Very truly yours,
Arnold Benson
President
Pecos Light & Power Co.
Pecos, New Mexico

(Editors Note—Electrical World will be happy to loan track shoes to free private enterprisers en route Pecos with an answer)

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Large growing, suburban utility on Eastern Seaboard needs Electrical Engineer for Distribution Engineering work. Applicant must have broad utility experience with ability to co-ordinate all phases of work of an entire department, prepare budgets and reports, make engineering studies, prepare specifications and assist in general administration.

Applicants will please submit complete resume of personal background, education, experience and salary expected.

P-1600, Electrical World
330 W. 42nd St., New York 18, N. Y.

ELECTRICAL DESIGNERS

ESTABLISHED BOSTON CONSULTANTS HAVE OPENINGS FOR ELECTRICAL ENGINEERS AND DESIGNERS WITH POWER PLANT AND INDUSTRIAL DESIGN EXPERIENCE.

P-1618, Electrical World
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REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
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POSITIONS VACANT

SALES ENGINEER and/or Manager. Power and Distribution Transformer experience, exceptional opportunity for right background. Larkin Transformers, Pine Bluff, Arkansas.

DEVELOPMENT AND Application Engineer. Experienced in designing building, and field application of specialized electrical and mechanical instruments and test equipment. Opportunity to introduce, develop and apply new test equipment in utilities, industrials and railroads. Well-established, medium-size company. Location east. P-1937, Electrical World.

SELLING OPPORTUNITY OFFERED

SALESMAN OR Engineer now visiting utilities to handle reconditioned watthour meters, parts, etc. Commission basis. SW-1933, Electrical World.

WANTED
ELECTRICAL ENGINEERS

One with experience in the sale of transmission line materials. Background of selling to private utilities very desirable. Will also contact public utilities, rural co-operatives and power line contractors. Considerable traveling.

Another who knows design, production and sale of transmission line accessories. Must be qualified to direct complete program.

Salaries equal to qualifications. Please send picture along with outline of education and experience. State position for which you are applying.

P-1880, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

ELECTRICAL CABLE SALES

Opening Senior Sales Staff, Electrical Cable manufacturer. National Distribution. Prefer engineer private utility background and national contact. Salary open. Send complete resume. Confidential.

SW-1902, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

WANTED
POWER SALES ENGINEER

for sales development work with industry and the farm. Engineering graduate, age 30 - 35, sales experience desirable. Good opportunity with small progressive electric utility in Ohio. Write, giving full information and salary expected.

SW-1943, Electrical World
520 N. Michigan Ave., Chicago 11, Ill.

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SALARIED POSITIONS $3,500-$25,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (40 years recognized standing and reputation). The procedure is highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present positions protected. Send only name and address for details. R. W. Bixby, Inc., 242 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

WANTED: POSITION as meter tester or meter repair. Several years experience in testing. PW-1778, Electrical World.

CONSTRUCTION SUPERINTENDENT Substations, Transmission and Distribution Lines and underground systems. Good estimating and organizing ability. Employed, prefer change domestic or foreign. References and interview. PW-1915, Electrical World.

GRADUATE ELECTRICAL Engineer, 38, married, 15 years hydropower, utility, industrial engineering, planning, administration in Americas and Europe desires responsible position with utility, large mining or industrial enterprise in Northwest, Canada or Alaska. Replies: PW-1941, Electrical World.

ELECTRICAL ENGINEER, reg., 35, eleven years power system operation, control and protection, calculating board exper., desires employment with private utility. PW-1898, Electrical World.

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May be inspected in operation at Municipal Generating Station, Rockville Centre, N. Y., anytime prior to February 10, 1950. Will be sold "as is—where is", purchaser to remove prior to March 15, 1950.

Offers will be received to 2:00 P. M. February 10, 1950, by the **Commissioner of Public Utilities, Rockville Centre, N. Y.** Write for further information.

FOR SALE
Minneapolis-Honeywell Regulator Co.'s
100 pcs. RALL7A PROTECTO RELAY 230 volts 50 Cycles.
100 pcs. L178A AQUASTAT 15-100°C.
Brand new in original package.
Asking 25% under prevailing factory price.
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1—General Electric Co. 375 kva. 2400 volt delta, 60 cycle, 1200 RPM A.C. generator, with direct connected 125 volt D.C. exciter. In new condition.

Directly connected to

1—Sterling Engine Co. 8 cylinder, 565 H.P. internal combustion gasoline engine, 1200 RPM water cooled with dual ignition and dual starters.

Entire unit operated less than 100 hours and available immediately.

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Description Generator:	Description Motor:
1.25 KW—1200 Volts	H P 3 Volts 115
1.04 Amps	Amps—27
Hrs. 24 C-Rise 60	A.C. Output 450 Watts
Seq'ly. Excited at 115 Volts	81 Volts 60 Cycle
Max. Excitation Amps. 3	2.6 Amps
Style 89C 755	1800 R.P.M.
	Serial # 4674392

2—D.C. 2 Man. Hand Electric Drills. Used

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1 675 HP. Worthington **Air Injection Diesel Engine.**
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Including all auxiliaries, motor, generators, etc.
Can be seen in operation any time.
Contact Mayor or City Clerk
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4—1677 KVA Standard transformers, subtractive polarity 13200 to 2400 volts, 2-2½% taps above and below. Two years in service.
4—1000 KVA Standard transformers, subtractive polarity 13200 to 2400 volts, 2-2½% taps above and below. Two years in service.
3—500 KVA Rebuilt Pittsburgh transformers, subtractive polarity 13,800 to 2300 volts, 4-2½% taps below. Fifteen years in service.
2—1000 KVA General Electric transformers, subtractive polarity, 13,800 to 2300 volts, 5-2% taps below. Fifteen years in service.
1—Westinghouse three phase regulator—13,800 volts, 10% plus or minus. Two years in service.

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GE type VM 3A with M20 Dem. Reg.
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KW	Make	Desc.
4000	G.E.	Auto extraction—250 lbs. I.S.P. 35 lbs. ext.—2300 v. 3 ph. 60 cy.
750	G.E.	Condensing—250 lbs. I.S.P. 440 v. 3 ph. 60 cy.—Built 1944
300	G.E.	Non-condensing 150/175 I.S.P. 5/10 B.P.—480 v. 3 ph. 60 cy.
400	Whse.	Non-condensing 125/150 lbs. I.S.P. 8/10 lbs. B.P.—240/480 v. 3 ph. 60 cy.

SYNCHRONOUS CONDENSERS

KVA	Make	Type	Volts	Speed
5140	Whse.		2400/4150	600
4000	G.E.	TSC	2400/4150	900
3000	Whse.		2400/4900	720

MOTOR GENERATOR SETS
3 ph. 60 cy.

KW	Make	Speed	DC Volts	AC Volts
1800	G.E.	600	125/250	2300/4150
1500	G.E.	360	275	2200/4400
1500	G.E.	600	600	2300/4150
1250	G.E.	600	275	4150
1000	Whse.	900	600	4150

TRANSFORMERS—60 Cycle

Kva	Make	Type	Ph	Voltages
2666	Whse.	OISC	1	66000x11000
2500	Al. Ch.	OISC	3	13200x2300
2500	Pack.	AT	3	13800x2300
1250	G.E.	HVDDJ	1	6600x550
1000	Pitts.	OISC	1	13200x2300
600	Al. Ch.	OISC	3	2300/4150x2300/440
333	Pitts.	OISC	1	26400x2600
167	G.E.	IH2	1	2400x2400/480

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3000	KW	G.E.	25/60 cy. 2300/2300 v.
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We cannot guarantee them after being put into service where loading is out of our control but do guarantee them for any normal transformer test before use.

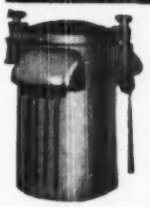
Qu.	Mfg.	KVA	Sec Voltage	Type	Mfg. Yr.	Price each
1	W.H.	200	120/240	S	1940	$650
1	W.H.	200	120/240	S	1946	750
7	A.C.	150	240/480	CBS	1948	700
2	W.H.	75	120/240	S	1946	350

Serial numbers on request.

All prices f.o.b., Columbia, Tennessee. Subject to prior sale. Within the next few months we will have 2400/120/240 Volt transformers available in sizes from 3 KVA to 50 KVA all in good condition and some practically new.

COLUMBIA POWER SYSTEM
COLUMBIA, TENNESSEE
PHONE 600

-TRANSFORMERS-



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We carry a large stock of transformers, and invite your inquiries.

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We rewind, repair and redesign all makes and sizes. One Year Guarantee.

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1—2500 HP G.E. MT 257 RPM 6600V
1— 500 HP G.E. MT 720 RPM 2200 V 4150

SYNCHRONOUS CONDENSER
1—2500 KVA Whse 720 RPM 2200 V with D.C. Exc.

MOTOR GENERATORS
1—1000 KW Whse 275 V 720 RPM 4150 Volt
1—1000 KW G.E. 600 V 514 RPM 2200/4000 V
1— 500 KW G.E. 275 V 900 RPM 4150 Volt
2— 150 KW G.E. 125/250 V 1200 RPM 4150 Volt

TRANSFORMERS
1—1500 KVA G.E. 3 Ph. 4150 V 480 V Pyranol
1—1000 KVA G.E. 3 Ph. 4150 V 2400 V
1—1000 G.E. 3 Ph. 4150, 2 Ph. 2400 V
2— 750 KVA G.E. 3 Ph. 4150 V 480 V Pyranol
3— 400 KVA G.E. 6900 2300 V Sec.
3— 100 KVA G.E. 4150-240/480 V Pyranol
3— 75 KVA G.E. 2400-240/480 V
3— 75 KVA Whse 2300 230/115
3— 50 KVA Whse 2400-240/120
5— 50 KVA Whse 4150-120/240 Isertsen

Complete Line of A.C. and D.C. Motors and Generators

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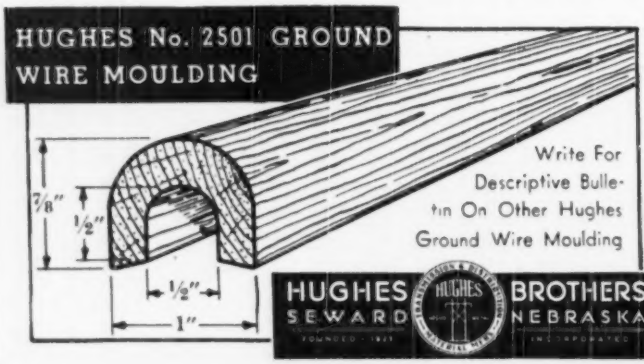

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Ask for Publication 4807.

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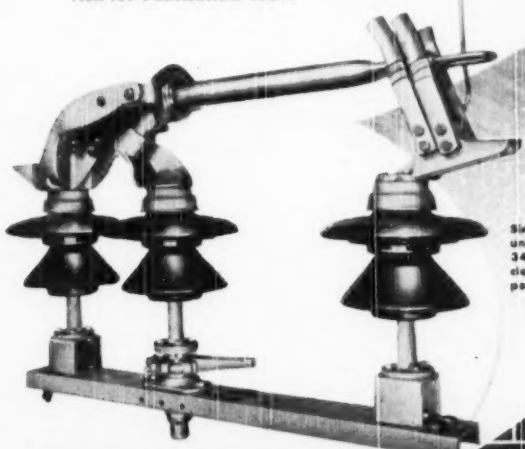
Blade is under positive control thruout entire opening or closing operation



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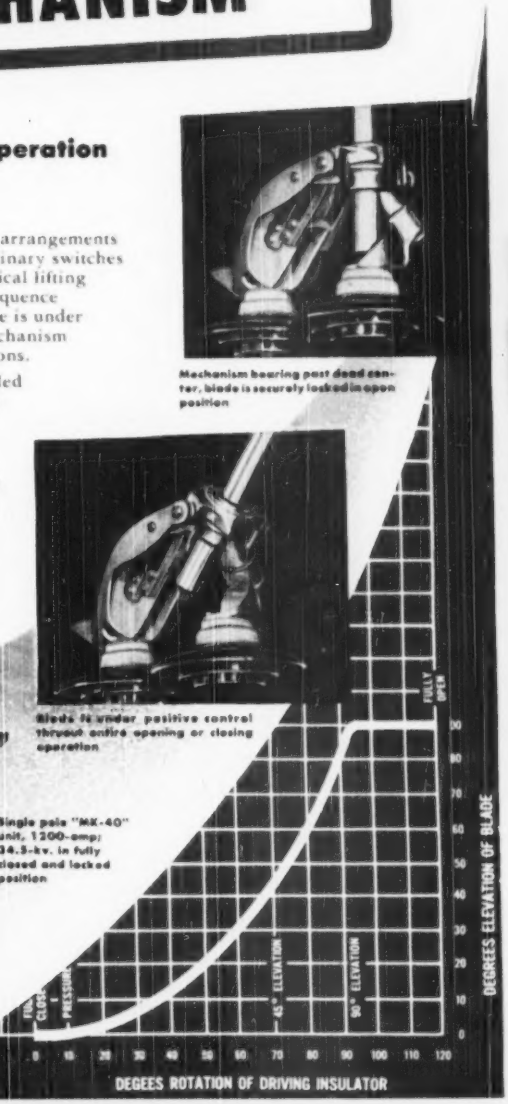
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90° ELEVATION
DEGREES ELEVATION OF BLADE
0 10 20 30 40 50 60 70 80 90 100 110 120
DEGEES ROTATION OF DRIVING INSULATOR

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